

**Rome at Its Core:
Reconstructing the Environment and Topography of the Forum Boarium**

by

Andrea L. Brock

**A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Classical Art and Archaeology)
in the University of Michigan
2017**

Doctoral Committee:

**Professor Nicola Terrenato, Chair
Professor Elaine Gazda
Dr. Laura Motta
Professor Christopher Ratté
Professor Celia E. Schultz**

Andrea L. Brock

albrock@umich.edu

ORCID iD: 0000-0001-5390-7499

© 2017 by Andrea L. Brock

To my father,
with whom I spent many happy days on the banks of the Ohio River.

Acknowledgements

I am extremely grateful for the support and assistance provided by numerous people and institutions. This project would not have been possible without them. I am especially thankful for the guidance provided by my advisor, Nicola Terrenato, who helped and encouraged me to actualize even seeming farfetched ideas. Nic gave me the opportunity to pursue my research interests unfettered and to their fullest extent. I could not have asked for a more supportive mentor.

Numerous colleagues and friends contributed their time and minds to this project. Although I reference various collaborative relationships throughout this dissertation, I would like to acknowledge the participation of Laura Motta and Daniel Diffendale, who made stressful and perplexing research a far more enjoyable and productive endeavor. I am also grateful for the students and faculty of the Interdepartmental Program in Classical Art and Archaeology, who provided me with a vigorous learning environment for the past seven years.

Funding for my field research was generously provided by the Etruscan Foundation, Lemmermann Foundation, and the Horace G. Rackham Graduate School. During the 2015-2016 academic year, I was fortunate to be the Sylvia Engle Graduate Student Fellow at Michigan's Institute for the Humanities, an ideal setting as I began to write in earnest. I was supported by a Mellon/ACLS Dissertation Completion Fellowship as I completed this dissertation in 2016-2017.

Lastly, my biggest debt of gratitude goes to my family, who have supported and encouraged me through every step of my education. I could not have done this without my mother (my first teacher and editor) or my husband, Zach (my greatest interlocutor).

Table of Contents

Dedication	ii
Acknowledgments	iii
List of Tables	viii
List of Figures	ix
Abstract	xiii
Introduction	1
<u>Chapter 1 - The Historiography of Early Rome: applications and limitations</u>	<u>11</u>
Brief introduction to the historiography of Early Rome	11
Skeptical approach	17
Positivist approach	19
Four case studies	21
Rome's pre-urban landscape	22
Topography of the Forum Boarium	25
Floods and their effects	29
Human response to flooding	32
Utilizing historical sources in environmental reconstruction: a moderate positivist approach	33
Conclusions: Interweaving literary, archaeological, and environmental evidence on Early Rome	38

<u>Chapter 2 - Human Ecology Theory: elucidating past human-environment</u>	
<u>interactions in river valleys</u>	<u>41</u>
Towards an understanding of human-environment relationships	42
Cultural responses to environmental tress	45
Human adaptation to floods	47
Conclusions: some hypotheses for Early Rome	52
<u>Chapter 3 - Digging in the Valley: geoarchaeological methods and data</u>	<u>56</u>
Deep trench excavation at Sant’Omobono	62
Coring survey at Sant’Omobono and in the Forum Boarium	65
Coring survey: stratigraphy, sampling, and chronology	69
Conclusions: implementation in other urban contexts	76
<u>Chapter 4 - Reconstructing the Pre-Urban Landscape of the Forum Boarium</u>	
<u>Valley</u>	<u>79</u>
Reconstructing the pre-urban topography of the river valley	82
River channel	86
Raised floodplain	88
Velabrum lowland	90
Hydrology	94
Towards a visualization of the pre-urban landscape	98
The birth of Rome: a hut settlement on the Capitoline Hill	99
Conclusions: envisioning the prehistoric harbor in the Forum Boarium valley	103
<u>Chapter 5 - Urbanizing the Landscape: The development and decline of Rome’s</u>	
<u>original river harbor</u>	<u>108</u>

Early Archaic Period: a city rises	109
Construction of Rome's first harbor temple	111
A new challenge: floods and sedimentation	114
Explaining the sedimentation	115
Late Archaic Period: adaptation and renovation	123
Renovation of the harbor sanctuary	124
Dredging activity	126
Republican Period: maintenance and abandonment of the harbor	130
Conclusions: Rome's first conquest	135
Conclusion	138
Tables	143
Figures	152
Bibliography	184

List of Tables

Tab. 1	Chronological markers from the Sant’Omobono and Forum	
	Boarium boreholes	144
Tab.2	Key elevations (masl) from the Sant’Omobono and Forum	
	Boarium boreholes	148
Tab. 3	Radiocarbon results from the Sant’Omobono and Forum	
	Boarium boreholes	150

List of Figures

Fig. 1: Map of central Italy	153
Fig. 2: Map of Rome with key hills and valleys labeled (Aldrete 2007, fig. 1.2)	153
Fig. 3: Map of the Tiber River's catchment basin (Aldrete 2007, fig. 2.4)	154
Fig. 4: Sketch of Rome's natural landscape drawn by Giovanni Battista Brocchi in 1820 ("La carta fisica del suolo di Roma")	155
Fig. 5: Sketch of Rome's natural landscape drawn by Rodolfo Lanciani in 1897 (Lanciani 1897, fig. 1)	155
Fig. 6: Plan of the Forum Boarium valley in the Imperial era (Coarelli 2007, fig. 85)	156
Fig. 7: Photo of the Palazzo dell'Anagrafe and Rome's modern river embankments, viewed looking east from the Tiber Island (Lindvall forthcoming, fig. 2)	157
Fig. 8: Sketch plan of the Forum Boarium by Filippo Coarelli in 1988 (Coarelli 1992, 241)	157
Fig. 9: Sketch map of the Archaic Portus Tiberinus by Giovanni Ioppolo in 1989 (<i>Il Viver Quotidiano in Roma Arcaica: Materiali dagli scavi del Tempio Arcaico nell'area sacra di S. Omobono</i> , fig. 3)	158
Fig. 10: Sketch visualization of the Archaic Portus Tiberinus by Giovanni Ioppolo in 1989 (<i>Il Viver Quotidiano in Roma Arcaica: Materiali dagli scavi del Tempio Arcaico nell'area sacra di S. Omobono</i> , tav. 1)	159

Fig. 11: Detail view of the Forum Boarium district from the model of Archaic Rome at the Museo della Civiltà Romana, built by Lorenzo Quilici in 1990	160
Fig. 12: Photo of the Round Temple in the Forum Boarium during a flood in December 1900	161
Fig. 13: Map of Augustan Rome during a major flood to an elevation of 20masl (Aldrete 2007, fig. 1.10)	162
Fig. 14: Map showing the depth of fill in Rome's valleys (Aldrete 2007, fig. 1.5)	163
Fig. 15: Cross section of the building phases at the Sant'Omobono Sanctuary (G. Ioppolo)	163
Fig. 16: Plan of the Sant'Omobono Sanctuary showing the outline of the Early Archaic podium buried beneath the Late Archaic platform that supports the twin temples of Fortuna and Mater Matuta along with their associated altars (D. Diffendale)	164
Fig. 17: Plan of the Velabrum valley showing the location of 24 cores produced by Albert Ammerman in the 1990s (Ammerman et al. 2008, fig. 1)	165
Fig. 18: Photo of the archaeological site of Sant'Omobono, looking north (P. Brocato)	166
Fig. 19: Plan of the Sant'Omobono Sanctuary showing the location of deep investigations in 2013-2014, including trenches A7 and D10 and percussion cores SO 14-37 (D. Diffendale)	167
Fig. 20: Plan of the Forum Boarium showing the locations of the Sant'Omobono Sanctuary and mechanized cores FB 38-49 produced in 2015 (D. Diffendale)	168
Fig. 21: View inside deep trench A7 during excavation in 2014 (D. Diffendale)	169
Fig. 22: View of the Archaic podium during excavation in deep trench D10 in 2013	169

Fig. 23: Composite photo of the interior wall of the Late Archaic platform following excavations of deep trench A7 in 2014 (D. Diffendale)	170
Fig. 24: View of percussion coring underway inside the western cella at Sant’Omobono in 2013	171
Fig. 25: View of three sections from a single sediment borehole produced during the percussion coring survey of the Sant’Omobono Sanctuary	171
Fig. 26: View of the drilling machinery during work on core FB 39 behind the Temple of Portunus in 2015	172
Fig. 27: View of five sections from a single sediment borehole produced during the mechanized coring survey of the Forum Boarium in 2015	173
Fig. 28: Photo on the balcony of the Sant’Omobono church, showing a portion of the mechanized boreholes produced in 2015	173
Fig. 29: Profile drawings of boreholes that exposed stratigraphy associated with the Capitoline Hill and the floodplain beneath the Sant’Omobono Sanctuary, including FB 41-42, SO 14-18, SO 22-26, SO 31-37	174
Fig. 30: Profile drawings of boreholes that exposed stratigraphy associated with the Tiber’s river channel, including FB 43-49, SO 30	175
Fig. 31: Profile drawings of boreholes that exposed stratigraphy associated with the Velabrum valley, including FB 38-40	176
Fig. 32: Contour map of Rome with the main topographical features marked and the lowland areas susceptible to flooding shown in light grey (Motta 2011, fig. 14)	177
Fig. 33: Sketch of Rome’s natural landscape, showing key topographical features and roadways in early Rome (Coarelli 1992, 108)	178

Fig. 34: Aerial photo of the Forum Boarium valley marked with key topographical features revealed by this project	178
Fig. 35: Superposition of a plan of the Forum Boarium on the “Carta Geologica del Centro Storico di Roma” (Funiciello et al. 1995), showing deposits of volcanic tuff (pink: Tufo Lionato; purple: Tufo del Palatino) that cover fluvial deposits of the Paleo-Tiber (green)	179
Fig. 36: Schematic diagram of the stratigraphy in the Forum Boarium	180
Fig. 37: Southwest-northeast profile of the natural relief of the Forum Boarium valley from the Tiber’s channel to the Capitoline Hill	181
Fig. 38: Graph of the sedimentation rate in the Tiber channel in the Forum Boarium from the third through the first millennia BCE, showing a modest sedimentation rate of ca. 23cm/century prior to the early sixth century, after which 5.8m of sediment was deposited in a century	182
Fig. 39: Map of <i>emporium</i> infrastructure in the Testaccio region southeast of the Aventine Hill (Coarelli 2007, 332)	183

Abstract

This dissertation presents the results of a recent geoarchaeological investigation in the heart of Rome. Using an interdisciplinary approach with underutilized methodologies, namely coring survey and environmental sampling, I have been able to investigate deeply buried levels in Rome's river valley, called the Forum Boarium. This region marks the site of Rome's original river harbor and an important crossroad in prehistoric central Italy. By drilling a series of cores that produce sediment boreholes more than 15m long, it becomes possible to survey previously inaccessible archaeological and geological stratigraphy across a wide area and with great depth. As coring survey effectively explores the interactions and relationships of past peoples with their landscape, utilization and refinement of these techniques will help launch promising new research in the field of environmental history.

In the case of Rome, environmental archaeology offers new perspective on the nascent city by providing data on the pre-urban environment and urban development of Rome's river valley. Among other things, my survey exposed key features of the natural landscape in the Forum Boarium, including the location of Rome's original river harbor and the nearby section of raised floodplain at the base of the Capitoline Hill. I argue that Rome's origins as a harbor settlement helped the city achieve regional dominance from its inception. Moreover, I posit that the exponential growth of trade between Etruria and Greece in the seventh century BCE created new opportunities, which motivated the early inhabitants of Rome to begin engaging in large

scale building and landscape modification projects, aimed at building a cohesive city that could also be protected from nuisance flooding.

The substantial dataset produced by coring survey and environmental sampling provides an empirically-driven timeline for Rome's urbanization process, corroborating a rich archaeological and literary record that signals sixth century Rome as transformative and exceptional. The available paleoenvironmental evidence suggests that the Tiber riverine system was relatively stable during the early centuries of human habitation at the site of Rome, but sometime after the early sixth century the Tiber began a process of rapid aggradation. Between 580 and 480 BCE, 5.8m of sediment was deposited in the Forum Boarium. This sedimentation rate represents a significant hydrological shift in the Tiber basin well beyond the norm of nuisance flooding, which I argue is a direct consequence of the Romans' prolific urban activities on the local landscape. I introduce evidence for dredging in the Forum Boarium as early as the fifth century BCE as one of a variety of flood-mitigating activities pursued in Rome. In sum, this project shows how environmental pressures not only shaped the physical landscape of the early city, but also emergent socio-political institutions, as the Romans were compelled to adapt to their volatile river in order to protect important ritual and commercial pursuits in the Forum Boarium valley.

Introduction

The modern metropolis of Rome preserves few remnants of the area's original environment. Millennia of urban development have dramatically transformed the original landscape: the hills have been quarried, the valleys filled, and the course of the Tiber River shifted and ultimately canalized within massive retaining walls in the late 19th century. This contemporary visual appearance complicates efforts to study Rome's origins, as the material record from the city's early history has either been completely obliterated or buried under several meters of urban accumulation. While discussions of prehistoric Rome often emphasize activity on the hills, where there is archaeological evidence of habitation and agricultural land use from the late second millennium,¹ scholars tend to discount the lowlands as inhospitable or unsuitable for urban development due to their susceptibility to recurrent inundations of the Tiber.² Recent decades, however, have witnessed the growth of geoarchaeological research, which has reshaped traditional assumptions by providing the first empirical evidence for the original topography and environment of Rome's valleys.³ Although the hills did provide a secure setting for the growth of permanent domestic space, it is becoming increasingly apparent that the Tiber River and a natural harbor in the Forum Boarium valley—perhaps more than the iconic seven hills—that had a profound impact on the birth and growth of a city. This specific

¹ Coarelli 1992, 112; Carandini 1997, 126-27; Cazzella 2001; Filippi 2005, 98-100; Cazzella et al. 2007; Alessandri 2013, 15; Fulminante 2014, 69-72.

² Heiken et al. 2005, 59-84; Aldrete 2007, 10-50; Hopkins 2014, 30; 2016, 39-65.

³ e.g., Ammerman 1990, 2013; Heiken et al. 2005; Hopkins 2007, 2014.

location in the Tiber River valley had rare potential for sustaining cultural growth as it provided invaluable access to regional resources, trade, and communication, all of which made it possible for people to settle and thrive at the site of Rome.

Long before the ancient Romans began accruing their Mediterranean empire, the Romans faced the more practical, but nonetheless daunting challenge of urbanizing a dispersed set of hills rising out of a floodplain. Their reasons for building a city here are clear: this position offered abundant natural resources and ready access to wider exchange networks. According to Livy, a historian of the Augustan age:

“Not without reason did gods and men select this position for the foundation of the city: the most refreshing hills, the convenient river, by which the produce from inland locales is conveyed down, and by which maritime trade is obtained, a place close enough to the sea for the comforts but not too exposed by proximity to the dangers of foreign fleets, a region in the middle of Italy, a spot uniquely destined for the growth of a city.”⁴

Some might, understandably, disregard this passage as teleological propaganda or rhetorical flourish—Livy is, after all, recounting the speech of M. Furius Camillus, as the dictator beseeched his fellow citizens not to abandon their city after the Gallic sack. I contend, however, that this passage quite accurately describes the conditions of Rome’s beginnings. Despite the disjointed topography and the threat of Tiber floods, this location *was* destined for the growth of a city. The city of Rome sprouted at an opportune crossroad on the boundary between two major cultural groups in prehistoric Italy: the Etruscans and Latins, whose territories were separated by the Tiber River (**fig. 1**). Sailors of the Mediterranean Sea, finding no convenient harbor on the

⁴ Livy 5.54.4: *Non sine causa di hominesque hunc urbi condendae locum elegerunt, saluberrimos colles, flumen opportunum, quo ex mediterraneis locis fruges devehantur, quo maritimi commeatus accipiantur, mari vicinum ad commoditates nec expositum nimia propinquitate ad pericula classium externarum, regionum Italiae medium, ad incrementum urbis natum unice locum.* cf. Dionysius of Halicarnassus’ (*Ant. Rom.* 3.44.2-3) account of the landscape and river navigation in the early city. All translations are my own.

Tyrrhenian coastline, could enter the mouth of the Tiber and sail 25km upstream to a sharp bend in the river at its confluence with two tributary streams. Here, a slower current and shallower waters provided a convenient place to beach their vessels and access either bank of the river; this natural harbor and convenient river crossing acted as a natural funnel by directing the movement of people and resources in the region.

Since at least the late second millennium BCE, people have sought to occupy the cluster of hills on the east bank of the Tiber, where they would have been able to control this strategic location in the river valley, a region later known as the Forum Boarium (**fig. 2**). The emergence of a permanent settlement at the site of Rome occurred alongside similar social transformations across central Italy in the Late Bronze Age. In addition to the growth of stable communities, this period marks the proliferation of intraregional exchange networks,⁵ which would have converged to some extent on the Forum Boarium valley. The arrival of Greek colonists and craftspeople to Italy in the eighth century BCE and the resultant intensification of interregional trade between the peoples of Italy and Greece led to a surge in material wealth, particularly in the region of Etruria. From the late seventh through the late sixth century, some generations after cities began to take root in Etruria, a massive investment in large-scale constructions and landscape modification transformed Rome from disjointed settlement to unified city. As would be expected given its position at the intersection of multiple ethnic groups, the material culture of this nascent city was diverse, showing clear signs of Latin, Etruscan, and Greek influence.

Long studied through historical and archaeological approaches, this complex urbanization process that occurred in central Italy from the Late Bronze Age (1300-900 BCE) through the Archaic Period (580-480 BCE) dramatically altered the landscape, a fact particularly true for

⁵ Blake 2014, esp. 34-42, 87-112.

Rome's river harbor. Through my geoarchaeological research in the Forum Boarium, I have uncovered new evidence on Rome's pre-urban landscape and early urban transformations in the river valley. These results quantifiably illustrate the timeline for Rome's transition from settlement to city and shed new light on the ecological consequences of this rapid urban development. This history—of how the Romans confronted and conquered her landscape—has yet to be written, but early forays indicate a wealth of research possibilities.

The present project complements and extends current scholarly attempts to reconstruct paleolandscapes both in Italy⁶ and across the Mediterranean,⁷ projects which must employ a cross-disciplinary approach to better understand human–environment interactions in prehistoric and historical periods. New evidence demonstrates that the original landscape was a peculiar product of human and geological processes that carved Rome's hills and filled her valleys over millennia. The situation is clear: the best way to open access to early Rome is through the environment. Landscape studies and examinations of human-environment interactions in the past can unlock new research questions and offer new answers. The success of this approach lies in its inherent necessity for cross-disciplinary methods and data, an asset as well as a real logistical hurdle that has long stunted historical research on ecological subjects. At Rome, environmental archaeology is beginning to tell new tales and shed light on old mysteries.

This dissertation is broken into five discrete, but interrelated components. **Chapter 1** reviews the extensive historiography of Early Rome, including contributions from both modern and ancient historians. Although the ancient literary account of Rome before the mid-Republican period has been variously maligned and undermined, I argue that the textual record can provide

⁶ e.g., Sadori et al. 2004; Bellotti et al. 2007; Testa et al. 2008; Bini et al. 2009; Motta 2002, 2011; Amorosi et al. 2013; Arnoldus-Huyzendveld et al. 2013; Borrelli et al. 2013.

⁷ e.g., Pucci et al. 2011; Fulani et al. 2013; Stock et al. 2013; Giaime et al. 2017.

valuable, reliable information on the city's landscape and urban evolution in earlier periods. After surveying the texts that are relevant to four topics relevant to this dissertation—Rome's pre-urban landscape, archaic urban topography, floods and their effects, and the human response to floods—I contend that the literary record has demonstrably preserved many accurate details from Rome's prehistoric past, specifically regarding environmental and topographic details. Throughout the rest of the dissertation, although I never build an argument from the literary record, I do reference or quote sections of ancient text when they provide helpful analogies or corroboration for my reconstruction of the geoarchaeological record.

Chapter 2 introduces the theoretical underpinning for this project, human ecology theory. My interests lie in illuminating human-environment interactions in the past, as I see this as a largely untapped venue of historical inquiry. By studying historical landscapes, it becomes possible to define better the space upon which cultural processes play out and identify the ways in which society shapes the space around them; such information can shed new light on past cultural processes. This task requires multivariate and multi-scalar research questions and data sets in order to describe complex and dynamic ecological systems in diachronic and processual terms. After an anthropologically driven discourse on mechanisms of human adaptation to floods, I conclude this chapter by offering some hypotheses for flood prevention and mitigation strategies employed in the ancient Forum Boarium.

Rome is a particularly fruitful case study for such an ecological study, as data can be drawn from a multitude of fields and decades of research. Indeed, this project would not have been possible without the copiousness of preexisting (some very recent) scientific, geological, historical, and archaeological scholarship on the Eternal City. Following a brief review of previous geoarchaeological investigations in Rome's valleys, I describe the methods employed in

this project in **Chapter 3**. As a member of the Sant’Omobono Project since 2011, I had the great opportunity to work on one of the few active archaeological investigations in the region of the Forum Boarium while participating in a new phase of field work aimed at investigating the earliest levels of the site, which are buried at a depth of 5m below the Republican surface. Deep trench excavation was an initial, albeit labor-intensive and costly means of reaching early levels in the valley. Supplementing and complementing these excavations, I designed and directed two phases of coring survey: a percussion coring survey at the site of Sant’Omobono in 2013-2014 and a mechanized coring survey of the entire Forum Boarium in 2015. This type of subsurface survey involves drilling cores several meters into the ground in order to produce sediment boreholes, which can be analyzed using a variety of geoarchaeological techniques. New data produced in this coring survey facilitated my ability to draw inferences concerning the form and formation of the Forum Boarium’s past landscape. After reviewing the sampling strategy and the chronological framework for the boreholes, this chapter concludes with some thoughts on how these empirical methods can be more widely applied, especially in other urban areas where levels associated with a city’s origins are deeply buried and difficult to access.

The reconstructions offered in Chapters 4 and 5 and the conclusions drawn therefrom would not have been possible without the involvement of many scholars, scientists, and students. In order to take advantage of all cutting-edge techniques and bring many minds to bear on expectedly complex and incomplete data set, I recruited more than 30 people to participate either in the fieldwork or the analytical phase of this project. Throughout this dissertation, I refer to specific collaborators and scientific analyses when relevant, but this list of participants serves to introduce the diversity of specialties and disciplines involved in this project:⁸

⁸ All errors are my own. Preliminary results from this project (Brock and Terrenato 2016; Brock 2016a; 2016b) are presented here and discussed in light of new evidence.

1. Nicola Terrenato, University of Michigan, Sant'Omobono Project Director
2. Paolo Brocato, Università della Calabria, Sant'Omobono Project Director
3. Jan Sevink, Universiteit van Amsterdam, physical geographer
4. Laura Motta, University of Michigan, paleoethnobotanist
5. Fabrizio Marra, Istituto Nazionale di Geofisica e Vulcanologia, geologist
6. Laura Sadori, Sapienza Università di Roma, pollen specialist
7. Daniel Diffendale, University of Michigan, total station and GIS specialist
8. Cristiano Nicosia, Université Libre de Bruxelles, micromorphologist
9. Patrizia Macrì, Istituto Nazionale di Geofisica e Vulcanologia, geomagnetism specialist
10. Fabio Florindo, Istituto Nazionale di Geofisica e Vulcanologia, geomagnetism specialist
11. Rachel Opitz, University of South Florida, topography digital modeling specialist
12. David Charles Fredrick, University of Arkansas, topography digital modeling specialist
13. Sanne Boessenkool, Universitetet i Oslo, ancient DNA specialist
14. Bas van Geel, Universiteit van Amsterdam, macrofossil specialist
15. Victoria Moses, University of Arizona, archaeozoology specialist
16. Carlo Regoli, Sapienza Università di Roma, ceramic specialist
17. Lorene Sterner, Kelsey Museum of Archaeology, graphic artist
18. Albert Ammerman, Colgate University, coring consultant (2012-2014)
19. Pinelopi Papika, coring technician (2013)
20. Vasilis Skentos, coring technician (2013)
21. Athanasios Skentos, coring technician (2013)
22. Stefania Pinzi, Istituto Nazionale di Geofisica e Vulcanologia, coring technician (2014)
23. Ivano Taranto, field assistant (2014)
24. Andrew Dodd, Western University, field assistant (2014)
25. Robert Woodcock, Western University, field assistant (2014)
26. Marcello Martinelli, CNG S.r.l., coring contractor (2015)
27. Susan Grouchy, Western University, field assistant (2014-2015)
28. Zachary Hallock, University of Michigan, field assistant (2015)
29. Cesar Ruiz, University of Michigan, paleoethnobotany assistant (2015)

Several analyses remain ongoing as material from the boreholes is still under study. The totality of scientific data will be presented by the appropriate scholar in later publications from the project, but here I present my interpretation of stratigraphic and chronological data from the 2013-2015 coring surveys. In the final two chapters I draw on this exceptional geoarchaeological dataset, in order to offer a new reconstruction of the Forum Boarium valley since the origins of human habitation at the site of Rome.

Although much scholarship on the Forum Boarium opens necessarily in the Archaic Period when archaeological and historical evidence becomes more prolific, discoveries made during this coring survey have produced ample new data on the landscape of the Tiber River valley as it changed over a geological timescale. The chronological focus of **Chapter 4**, to which I refer generically as “pre-urban,” is the lengthy period that precedes the sixth century urban boom at Rome, which is characterized by large-scale construction and landscape transformation projects. Commonly referred to as the Late Bronze and Early Iron Ages, the second and early first millennium BCE corresponds to the origins of sedentary habitation on the hills of Rome.⁹ After presenting a brief overview of Rome’s geology and previously known or hypothesized topographical features of the Forum Boarium valley, I discuss several discoveries made during my research, including the location of Rome’s original river harbor and the proximate existence of a raised section of floodplain at the base of the Capitoline Hill where stratified Late Bronze Age deposits were uncovered. For the purposes of this project, a “harbor” is defined as a natural area of water that is partially enclosed and provides a safe accommodation for berthing vessels. In contrast, a “port” refers to the man-made infrastructure in and around the harbor,¹⁰ while an “*emporium*” (Greek, ἐμπόριον) is the ancient term for a marketplace or center of commerce.

After offering a new, empirical reconstruction of the pre-urban landscape in the valley, in **Chapter 5** I track the urban transformation of the Forum Boarium from the sixth century BCE. This distinction, pre-urban vs. urban, may seem somewhat artificial, but it assuredly is not. New findings show that prior to the sixth century BCE the Forum Boarium valley was subject to

⁹ For general reference on chronological frameworks for early Rome, see Colonna (1974); Meyer (1983, esp. 91-5); Smith (1996; esp. 21-3, 34-7); Bettelli (1997); Fulminante (2014, 66-104). Suffice it to say that the periods of interest here are the origins of settlement at Rome and the gradual development of urban systems leading to the Archaic Period (580-480 BCE).

¹⁰ Definitions after Quinn 1961, 71-74.

nuisance flooding, but was otherwise a stable, relatively dry setting capable of supporting human activity around the river harbor. Beginning sometime in the early to mid-sixth century, conditions in the valley changed dramatically, and the Tiber's channel began a process of rapid silting. Explanations for this hydrological shift are explored, but the result is clear: almost as soon as the Romans began investing in large-scale urban infrastructure, their activities on the local landscape spurred unintended ecological consequences that further challenged their civic growth and prosperity. This valley that had been an idyllic river harbor before the inception of the city, became silted and flooded as the Romans built their city. A staggering amount of sediment—5.8m deposited in the relatively short period between ca. 580 and 480 BCE—would have seriously jeopardized boating and commercial operations on the Tiber. In this chapter I present new evidence of dredging in the river valley, before drawing on the literary record to discuss various methods of flood mitigation and silt removal that the Romans undertook between the sixth and second centuries BCE to maintain harbor operations.

Understanding Rome's origins as, first and foremost, a harbor settlement can explicate much of the city's early trajectory. The site of Rome—a collection of easily defensible hills, clustered around a natural harbor, just upstream from the mouth of the Tiber, with access to abundant natural resources and trade routes—was exceptional, and the inhabitants of these hills were poised to control the movement of people and goods in the region. In order to capitalize on these locational opportunities and construct a city at this strategic crossroad, the Romans had to contend with a fragmented and often volatile landscape, which may have been “destined for the growth of a city,” but was certainly not ideal for it. The implications of this project are numerous. A mounting collection of literary, archaeological, and environmental evidence converges on an image of the sixth century BCE as a transformative period for the people and

site of Rome. The broader cultural dynamics behind this phenomenon—familial relations, interstate connectivity, resource management—all play out on the landscape, so that by illuminating their setting, it becomes possible to see the actors more clearly.

Chapter 1

The Historiography of Early Rome: applications and limitations

Scholars have approached the study of prehistoric Rome in numerous ways, with varying levels of success and credibility. Given the limited accessibility of archaeological remains from pre-republican Rome, much emphasis has been placed on the extant literary tradition in order to glean details about the city's early development. Scholarly interest in Early Rome is not solely a modern phenomenon, as both Greek and Roman sources affirm an enduring interest in Rome's earliest history. This chapter considers the extent and nature of the ancient tradition on Early Rome—specifically accounts of the founding of Rome, the so-called regal period, and the early Republic—as well as its potential application to archaeological research. Ultimately, I conclude that the historical tradition is insufficient in regard to most details of socio-political developments in Early Rome, but that general descriptions of environmental and topographic subjects can prove to be useful and accurate if approached with an awareness of the texts' weaknesses and biases.

Brief introduction to the historiography of Early Rome

A written history of Early Rome began with significant contributions from Greek historians in the mid-fourth century BCE, if not earlier; this period corresponds with Rome's growing presence in central Italy and increasing contacts with the cities of *Magna Graecia* in

Campania.¹¹ The Sicilian Timaeus was the first to give a historical account of Rome from its foundation, although his text only survives today in fragments.¹² Later Greek historians (like Polybius, Posidonius, and Dionysius) use history and *mores* to understand the Romans as well as to reconcile the Greeks to their subordinate position within the Roman Empire.¹³ As a symptom of broader antiquarian curiosity, the Greeks of the Hellenistic period display great interest in stories that attribute a city's foundation to a specific founder at a particular time.¹⁴ In the case of Rome, this foundation motif typically takes the form of Trojan and/or Greek ancestors migrating to the Italian peninsula, where Romulus was eventually born.¹⁵ In his *Antiquitates Romanae*, Dionysius of Halicarnassus exploits this foundation story in order to rationalize Rome's dominance and to convince his Greek audience of the Augustan age that Rome actually had Greek origins.¹⁶

Political propaganda aside, the details of such foundation myths have little historical credibility.¹⁷ As an alternative theory to explain Rome's origins, archaeological evidence from across the Mediterranean reinforces the synoecism model, which purports a gradual emergence of statehood in Italy during the Early Iron Age as opposed to a specific day of foundation at the hands of an individual founder.¹⁸ It is likely that only colonies could reliably trace their origins to a specific founder or founding date. Disregarding mythical colonial ties between Alba Longa and

¹¹ Ogilvie and Drummond 1989, 1-2; Gruen 1992, 10; Wiseman 1995, 43; 2008, 231-235.

¹² Momigliano 1989, 89; Baron 2013. For extant fragments see Jacoby *FGrHist* 566.

¹³ Ando 1999, 7; Pelling 2007.

¹⁴ Cornell 1978, 134-135.

¹⁵ For general discussion, see Momigliano 1989, 56-62; Wiseman 1995, 1-13; Cornell 1995, 57-72; Fraschetti 2005.

¹⁶ Dion. Hal. *Ant. Rom.* 1.5.1-2; Hill 1961, 88; Momigliano 1989, 52; Gabba 1991, 93-98; Schultze 2000; Pelling 2007, 252-257.

¹⁷ cf. Wiseman (2007, 71; 2008, 310) and Carandini (1997, 14-18); see also discussion below.

¹⁸ For general reference on theories of state formation: Mommsen 1868, 46; Ward Perkins 1961; Barker 1981; Momigliano 1989, 63-82; Torelli 1989; Smith 1995, 1997; Cornell 1995, 92-103; Grandazzi 1997, 143-176; Terrenato and Haggis 2011; Fulminante 2014, 1-34.

the cities of Latium, the validity of accounts of Romulus' life and the events of 753 BCE are dubious at best.¹⁹

In addition to these Greek contributions to the historical tradition of Early Rome, the Romans began composing their own history in the third century BCE. The Romans were heavily invested in their traditions and the *mos maiorum*, a preoccupation that inspired an enduring fascination with their archaic history. This living tradition formed part of the cultural consciousness and, in turn, contributed significantly to the creation of a Roman cultural identity.²⁰ More than simply promulgating antiquarian curiosities, ancient historians actively employed lessons from archaic history as moral *exempla* to be studied during turbulent contemporary times.²¹

Influenced by the Greek historical tradition, the first Roman historian, Fabius Pictor composed his history in Greek. Seeking to explain Greek influence on Roman customs and institutions, he began his narrative from the origins to his own lifetime during the Second Punic War.²² In broad agreement with Greek accounts, Pictor presents Rome's traditional foundation story from Heracles' arrival in Italy down to Romulus, including an extended description of a flood of the Tiber, which was said to have deposited the infants Romulus and Remus at the foot of the Palatine Hill.²³ The preserved fragments from Pictor are more robust at the beginning of the story (where he could draw on established foundation myth) and the end (about familiar

¹⁹ Cornell 1995, 70-71. The foundation date is debated in the sources, ranging from 728-814 BCE. See Pallottino 1979, 205-206; Momigliano 1963, 96-97; 1989, 82.

²⁰ Cornell 1986b, 83.

²¹ Livy *Praefatio* 9-10; Levene 2007, 283; Pelling 2007, 256; Beck 2007, 264.

²² Timpe 1972; Frier 1979, 227-254; Rawson 1989, 425-426; Beck 2007, 259-261; Cornell *FRHist* I.160-178.

²³ As recorded in Dion. Hal. *Ant. Rom.* 1.79.1 = Cornell *FRHist* II.53. Flood story also recounted Ovid *Fasti* 2.390; Varro, *Ling.* 5.54; Livy 1.4-7; Plut. *Rom.* 3.4. See also Chapter 4 and Aldrete (2007, 10-13) for further discussion.

contemporary events), with a seeming abbreviated middle component on Archaic Rome.²⁴

Although this apparent emphasis or bias may be skewed by the fragmentary nature of the record, T.J. Cornell argues that the more superficial treatment of the late regal period and early Republic reflects the limited availability of sources from which the historian could draw.²⁵

Pictor's contemporaries and successors in the mid-Republic further promulgated the tradition of early Rome in both prose and poetry.²⁶ Members of the Roman aristocracy in the second century, including Cato the Elder and Calpurnius Piso Frugi, extended the historical tradition into the Latin language.²⁷ Although their histories survive only in fragments today, these mid-Republican writers provide the source material for much of the tradition contained in the writings of later historians. The literary record that emerges in the Late Republic is more complete, but also heavily myopic. Book II of Cicero's *De Re Publica* is the best preserved historical account of Archaic Rome that pre-dates the Augustan author Livy, but Cicero's version did not reflect a tremendous amount of research and is heavily abbreviated in deference to philosophical dialogue.²⁸ Similarly, Sallust's *Bellum Catilinae* summarizes the whole of Roman history from Aeneas to Sulla, in an attempt to explain Rome's deterioration to the point of the Catilinarian conspiracy.²⁹ Although not writing in a traditional historical narrative form, the

²⁴ For extant fragments see Cornell *FRHist* II.32-105.

²⁵ Cornell *FRHist* I.170-171.

²⁶ All survive only in fragments, see Cornell *FRHist* II.106-287. Writing in the late third century, Gnaeus Naevius was the earliest Latin epic poet and opened his *Bellum Poenicum* with the founding of Rome by the grandsons of Aeneas. Writing in the early second century, Quintus Ennius began his epic poem, *Annales*, with Aeneas himself. Lucius Cincius Alimentus, Aulus Postumius Albinus, and Gaius Acilius, all senators of the early second century, also composed historical prose on Archaic Rome. See Rawson 1976, Cornell 1986a, Ogilvie and Drummond 1989, Beck 2007, and Cornell *FRHist* I.179-226 for general discussion.

²⁷ Rawson 1976; Timpe 1970; Cornell, *FRHist* I.191-218; 230-239 for further discussion. For extant fragments see Cornell *FRHist* II.134-243; 288-335.

²⁸ Cic. *De re pub.* 2.1-46; Rawson 1972, 43; Ogilvie and Drummond 1989, 2-3; Zetzel 1995, 13-17; Cornell 2001.

²⁹ Sal. *Cat.* 5.9-13.5; Levene 2007, 281.

antiquarian Varro provides numerous references to the history of language, religion, and other socio-political activities in Rome.³⁰ Most notably, Livy provides the first comprehensive account of early Rome, but this romantic and patriotic narrative is inherently tinged with bias. As clearly delineated in his *praefatio*, Livy emphasizes the moral lessons of the city's early history and seeks to make this available to his contemporaries.³¹

Following this climax in historical narrative with Dionysius and Livy in the Augustan period, interest in writing about Early Rome became less prevalent. An exception, however, is the inclusion of the biographies of Romulus and Numa in Plutarch's *Parallel Lives*, written in the early second century CE.³² The last comprehensive account of interest here is Cassius Dio's *History of Rome*. Expanding from the origins to his own day during the Severan period, the work was well researched and draws heavily on his predecessors' contributions to the tradition.³³

This survey of the state of the literary evidence underscores the fact that the historical tradition for Rome in the eighth through the sixth century was not recorded until the second half of the third century BCE.³⁴ By the time Livy picks up his stylus in the Augustan era, the events of interest to him are obscured by eight centuries of urban and cultural advancement, so much so that the author himself acknowledges the obscurity and unreliability of the record on Early Rome.³⁵ Although historians might have had access to early archival documents, those texts would have been of questionable significance to historical inquiry by the late Republic. The *Annales Maximi*, which ostensibly were a chronicle of historical and astronomical events

³⁰ Ogilvie and Drummond 1989, 10; Forsythe 2005, 64-68; Cornell *FRHist* I.412-423. For extant fragments see Cornell *FRHist* II.836-843.

³¹ Livy *Praefatio* 9-10; Ogilvie and Drummond 1989, 8-9; Gabba 1991, 93-98; Forsythe 1999, 65-73.

³² Ogilvie and Drummond 1989, 4.

³³ Millar 1964; Matthews 2007, 294-295.

³⁴ Wiseman 2008, 306.

³⁵ *Praefatio* 6; Wiseman 2008, 243-249.

maintained by the Pontifex Maximus, represent a potentially valuable source for ancient historians, but their content, purpose, and legibility remain unknown. Scholars disagree on the scope of the pontifical archives, when they began to be formally recorded, in what state they could have weathered the centuries, and ultimately how informative they could have been to early annalists.³⁶ Despite the limited record of these early texts, the *Annales*, as a source for the later Roman calendar or *fasti*,³⁷ could have preserved valid records of key events, notably including natural disasters, making them a potentially fruitful source for environmental histories especially. Additionally, Roman historians could have referenced a variety of public inscriptions, including documentation of treaties signed with neighboring peoples, such as those made with Carthage and Gabii,³⁸ and the mid-fifth century legal document known as the Twelve Tables.³⁹ In sum, this epigraphic evidence would have provided some source material for ancient historians to reference, allowing the potential for historically accurate and well-sourced information to be conveyed from the Archaic Period to writings of the Late Republic.⁴⁰

Given the relative dearth of documentary evidence from Rome before the third century BCE, the first historians of Rome would have drawn heavily from a pre-existing oral tradition, the veracity of which has been vigorously debated by modern scholars. Thus, the available primary source material on Early Rome is fragmentary, superficial in scope, and/or heavily

³⁶ Frier 1979, 161-178; Cornell 1986a, 53; Momigliano 1989, 97-88; Beck 2007, 261; Cornell *FRHist* II.141-159. Cicero (*De. Or.* 2.51-53) describes the *Annales Maximi*, but seems to place little value in yearly chronicles for the purposes of understanding history. For extant fragments: Cornell *FRHist* II.10-31.

³⁷ Cornell 1995, 12-16; Wiseman 2008, 262-270.

³⁸ Polybius (3.22-7) quotes the first treaty between Rome and Carthage made in 509 BCE, and Dionysius (4.58) mentions a treaty between Rome and Gabii that was displayed at a temple in Rome after their war in the Archaic Period (Livy 1.53.4).

³⁹ About 100 fragments survive, see Dirksen 1824. For background see Cornell (1995, 272-292) and Forsythe (2005, 201-233).

⁴⁰ Momigliano 1989, 87; Ogilvie and Drummond 1989, 11-14; 17-18; Cornell 1995, 103-104; 210-214; Serrati 2006.

slanted towards the authors' particular agenda, whether for antiquarian curiosity (as is the case with Varro and most of the Greek historians), moral edification (Livy, Sallust), political propaganda (Livy, Dionysius of Halicarnassus), or philosophical discourse (Cicero). The modern scholarly reading of and response to this fraught historiographic tradition can be split into two general camps: the skeptics and the positivists.

Skeptical approach

The fragmentary and problematic nature of the literary record has long discouraged and tainted modern historical investigations of Rome's origins. Led by two seminal figures in the field, criticism of the primary source material took root early on in scholarship from the mid-19th century. In his *Römische Geschichte*, Theodor Mommsen asserted that it is the duty of the historian to dismiss myths surrounding the origin of Rome.⁴¹ Similarly, George Cornwall Lewis argued that all information about early Rome should be rejected outright, unless it can be independently corroborated.⁴² Generations later, Andreas Alföldi sought to debunk insinuations drawn from the literary record that Archaic Rome was the supreme city among smaller Latin contemporaries, a vision further promulgated by archaeological discoveries showcased in Giorgio Pasquali's *La Grande Roma dei Tarquini*.⁴³ This trajectory of critical historiographic theory was an appropriate reaction to real problems with the literary record on Early Rome,

⁴¹ Mommsen 1868, 46-47; Fraschetti 2005, 113.

⁴² Lewis 1855, 243-244. Although archaeological corroboration is and was an ideal means of testing the historical record, archaeological research on early Rome is extremely limited, in large part due to problems with the accessibility of the archaic levels buried beneath more than two millennia of urban growth. While applicable in some valuable areas, substantial portions of the literary record will always lack archaeological comparanda.

⁴³ Pasquali 1936; cf. Alföldi 1965, 101-175.

namely the dearth of contemporaneous source material, but also served to marginalize the subject as an suitable venue for reliable and critical scholarship.

Building on the work of his predecessors, the most outspoken representative of this skeptical approach in recent scholarship is T.P. Wiseman, who has leveled numerous criticisms against the validity of sources on Early Rome in publications spanning several decades. First, he questions the applicability of the historical record by claiming that historians could not reasonably have acquired substantial knowledge of events before the late fourth century BCE. By the time the story was first written down, authors were synthesizing centuries of story-telling, well beyond the period of living memory.⁴⁴ With very little to contradict them, historians and dramatists had license to mold their fictions and the moral lessons therein. Moreover, the accounts of Early Rome often vary and contradict each other, undermining any likelihood of a single narrative that was widely accepted.⁴⁵ Wiseman further argues that historians of the Late Republic could simply ignore the myths of their cultural heritage.⁴⁶ Livy himself was elaborating a literary narrative that had been progressively created by his predecessors,⁴⁷ and even his version was whitewashed for the purpose of documenting moral *exempla* from the archaic past.⁴⁸ In addition to questioning the sources and motives of historians, Wiseman also claims that much of early Roman history was deliberately invented for the theater,⁴⁹ tracing the origins of the Romulus and Remus myth, for example, to stage performances at the end of the fourth century.⁵⁰

⁴⁴ Wiseman 2007, 71; 2008, 310; cf. Ogilvie and Drummond 1989, 23-24.

⁴⁵ Wiseman 1995, 13, 160.

⁴⁶ Wiseman 2008, 15.

⁴⁷ Wiseman 2007, 74-75.

⁴⁸ Wiseman 2008, 318.

⁴⁹ Wiseman 2007, 72-73; 2008, 238.

⁵⁰ Wiseman 1995, 89, 138-141.

The ultimate result—whether implicitly or explicitly stated—of this vein of scholarship is that nothing can be reconstructed from the historical texts before the fourth century.⁵¹ Instead, their historical value applies only to the era in which they were written, not to periods which they nominally describe. In other words, these texts should be studied primarily for their insight on contemporary socio-political dynamics, rather than as authentic historical accounts from Early Rome. Especially in an era without a canonized and documented historical narrative (such as the mid-Republic), the force of retrojection can dramatically influence the very creation of history by casting back contemporary themes onto past events. For example, descriptions of the so-called Struggle of the Orders are typically explained as retrojection: scholars often cite this pivotal negotiation between social classes not as a valid historical episode, but rather as a direct reflection of tensions that existed between patricians and plebeians in the Late Republic.⁵² Wiseman and other skeptics are indeed justified in using historical narratives for their insight on contemporary Roman culture. Ultimately, however, this approach denies the value of these sources in providing *any* kind of authentic history, a consequence of which is that the subject of Early Rome remains understudied and largely beyond the grasp of traditional historical inquiry. Those interested in the Rome's origins are therefore left bereft of the human voice that the literary record provides.

Positivist approach

In opposition to the skeptics, generations of scholars have accepted the historical tradition as factual to varying degrees. Giorgio Pasquali argued that the textual record of the archaic city was not simply the product of Romans glorifying their past, but rather a realistic portrayal of

⁵¹ Momigliano 1989, 56; Ogilvie and Drummond 1989, 16, 27-28; Gabba 2000, 16-19; Wiseman 2007.

⁵² e.g., Cornell 1986a, 52; Beck 2007, 263.

Rome as a supreme city in the region, comparable to other powerful urban centers across the Mediterranean in the Archaic Period.⁵³ Despite the skepticism of some historians, this grandiose vision of Early Rome nonetheless has permeated archaeological research on the city's origins. For instance, Andrea Carandini has long argued not only that oral traditions are capable of transmitting valid information over centuries, but also that so-called myths often preserve factual history.⁵⁴ Following his discovery of a section of an earthen wall that he has dated to the mid-eighth century on the northern slopes of the Palatine, Carandini hastily interpreted the feature as the Porta Mugonia gate that ancient sources identify as part of the Romulean wall that ran around the Palatine Hill.⁵⁵ This indiscriminate acceptance of the historical tradition and exploitation of dubious archaeological evidence to support this agenda has warranted much criticism and skepticism of Carandini in the scholarly community.⁵⁶

Although uncritical acceptance of the texts is naïve, other scholars maintain that there remains some potential for the memories preserved in the historical tradition to reflect truth.⁵⁷ T.J. Cornell is at present the most prominent apologist for the historians of Early Rome. He criticizes the skeptical proclamation that nothing before the fourth century can be reconstructed from texts as defeatist and tantamount to suggesting that it is simply impossible to study Early Rome at all.⁵⁸ Although he does not support the absolute accuracy of Rome's foundation myth with regard to figures like Aeneas and Romulus,⁵⁹ Cornell nevertheless is convinced that much

⁵³ Pasquali 1936.

⁵⁴ Carandini 1997, 14-18.

⁵⁵ Carandini 1997, 578-580, 2007, 49-50. This (fanciful) story earned New York Times press, see Suro 1988. For additional background on the Porta Mugonia and the Romulean wall, see Dion. Hal. *Ant. Rom.* 2.50.3; Richardson 1996, 304; Terrenato 1999; Coarelli 1999; Frascchetti 2005, 83-86.

⁵⁶ Fentress and Guidi 1999; Wiseman 2000.

⁵⁷ Pallottino 1979, 219; 1991, 26.

⁵⁸ Cornell 1986a, 64.

⁵⁹ Cornell 1995, 80.

of the story has merit and argues that the sources have actually preserved a great deal of truth from Rome's past. For example, Cornell cites the structure of the pre-Julian calendar as having preserved a list of festivals that date back to the legendary reign of Numa Pompilius in the early seventh century BCE.⁶⁰ In contrast to Wiseman's claim that Roman historians knew little about their archaic past and freely ignored the narrative regardless, Cornell counters that these authors actually had limited freedom to tamper with accepted narrative. With respect to the central outline of political and military events, which was a matter of public knowledge and formed a part of the elite consciousness, ancient historians would have been incapable of deviating from the conventional tradition.⁶¹ Moreover, he argues that Republican Rome was a living museum of sorts, with numerous physical remnants from the Archaic Period still visible.⁶² These surviving accounts, therefore, are not only representative of what Romans in the Late Republic believed about their own past, but they also preserve the memory of particular events from the Archaic period.

Four case studies

Thus far, this discussion has centered on Rome's early socio-political development, a reflection of the interests of both ancient authors and modern scholars. Of primary interest to this study, however, is the reliability and viability of a different thread in the literary record, namely its presentation of issues of environment and topography in Early Rome. Four subjects are particularly relevant to the present investigation: descriptions of Rome's pre-urban landscape, building activity in the Forum Boarium, the impact of floods on the city, and the human response

⁶⁰ Cornell 1995, 104-105.

⁶¹ Cornell 1986a, 56-58.

⁶² Cornell 1986a, 62-63. In response, Wiseman agrees, but suggests that these remnants could be easily misinterpreted (1986, 90).

to flooding. The following survey serves to illustrate how the later Romans understood and portrayed the role of the environment in the city's early history.

Rome's pre-urban landscape

In his version of Camillus' speech from 390 BCE, Livy cites the forethought of the gods and the founders for choosing an ideal location with healthy hills and convenient river to support the growth of a city.⁶³ In his abbreviated history of Early Rome, Cicero similarly praises Romulus' choice for locating his city and describes the valleys as especially salubrious and the Tiber steady.⁶⁴ Although both accounts are tinged with the teleological knowledge of Rome's eventual successes, these flattering descriptions are actually true to a point. Rome's position did offer numerous advantages, including strategic positioning on east-west and north-south trade routes, which contributed to the growth of trade networks and access to vital resources.⁶⁵ The hills were steep and easily defensible, providing a safe space for the growth of domestic space in the prehistoric era. Moreover, the Tiber would have served as a vital water source as well as an efficient means of transportation and communication between the sea and other Italian communities located further inland.

Rome's location was certainly fortunate but perilous as well. The city is situated in one of the most flood-prone sections of the Tiber, immediately south of the confluence with the Anio (modern Aniene) River (**fig. 3**).⁶⁶ Although the negative effects of flooding are highlighted in the next case study, it is worth noting Cicero's acknowledgement that Rome was located *in*

⁶³ Livy 5.54: *saluberrimos colles, flumen opportunum*; see full translation and quote in the introduction to this dissertation.

⁶⁴ Cic. *De re pub.* 2.10-11: *locumque delegit et fontibus abundantem et in regione pestilenti salubrem; colles enim sunt, qui cum perflantur ipsi tum afferunt umbram vallibus.*

⁶⁵ Toynbee 1970, 11-14; Grandazzi 1997, 74-91; Sallares 2002, 214.

⁶⁶ Heiken et al. 2005, 59-84; Aldrete 2007, 55; see further discussion in Chapters 4 and 5.

regione pestilenti.⁶⁷ Even into the modern era, illness is well documented in Rome and across Italy as a direct result of flooding and stagnant water, which breed mosquitoes and consequently malaria.⁶⁸ Varro even offers a warning about *animalia quaedam minuta* in marshy areas, demonstrating at least a rudimentary awareness of health issues associated with stagnant water.⁶⁹ The earliest case of malaria documented archaeologically in Italy dates to the fifth century CE,⁷⁰ and the incidence of malaria in Italy in earlier periods is based on circumstantial clues from skeletal remains.⁷¹ Indirect ecological evidence strongly indicates that early inhabitants of Italy would have also been vulnerable to the ravages of this mosquito-born disease, a conclusion further corroborated by modern epidemiological evidence demonstrating that as the Tiber overflowed its banks, the subsequent marshy lowlands could have served as a breeding ground for mosquitoes carrying malaria.⁷²

Extrapolating from literary references to swamps or flooded valleys,⁷³ scholars of Rome propagated a vision of permanently wet regions in the nascent city.⁷⁴ Early examples can be found in the 1820 map by Giovanni Battista Brocchi (**fig. 4**) and another in 1897 by Rodolfo Lanciani (**fig. 5**); both sketches include a swampy area in the Forum Boarium that extends from the riverbank into the Velabrum valley between the Capitoline and Palatine as well as between

⁶⁷ Cic. *De re pub.* 2.11; cf. Livy 5.48.1; Cato *De agr.* 1.3; Columella *RR* 1.5.3.

⁶⁸ Mommsen 1868, 46-47; Jones 1907, 73; Sallares 2002, 66-68; 204; Snowden 2006, 7-26.

⁶⁹ Varro *RR* 1.12.2. In an interesting comparison, Vitruvius (1.4.11) discusses the process of founding a city, including the possibility of building a town among swamps. He seems convinced that with the help of drainage, the swampland can serve as healthy locations for cities.

⁷⁰ The existence of malaria in the fifth century CE comes from Lugnano cemetery in Teverina, where DNA evidence from infant remains has confirmed the existence of a strain of malaria. See Soren and Soren 1995 and 1999 for further reading.

⁷¹ Skeletal remains from a necropolis outside of Metapontum has produced evidence of a genetic condition related to malaria. This constitutes indirect evidence for the existence of malaria in southern Italy as early as the sixth-fourth centuries BCE. See Sallares 2002, 105 for further reading.

⁷² Sallares 2002, 110; O'Sullivan et al. 2008.

⁷³ Ovid, *Fasti* 6.395-417; Varro, *Ling.* 5.43-44; Plut. *Rom.* 5.5; Prop. 4.9.5; Tib. 2.5.33.

⁷⁴ Platner and Ashby 1929, 549-50; Colini 1980, 44; Cressedi 1984, 250; Richardson 1992, 406-7.

the Palatine and Aventine hills (the Circus Maximus valley).⁷⁵ My project has confirmed the hypothesis, first advanced by Albert Ammerman, that the Velabrum, the lowland between the Capitoline and Palatine Hill encompassed by the Forum Romanum and Forum Boarium (**fig. 2**), was not a swamp but seasonally wet and dry. References to standing water in Rome's valleys likely reflect the effects of inundation, rather than a permanent condition in the early city.⁷⁶ It is not surprising that later Romans—themselves coping with the challenges of floods—assumed that their archaic predecessors were forced to deal with the constant existence of swamps or stagnant water, so the misconception of swampy valleys is a reasonable one. On a similar topic, Livy and Dionysius attribute the existence of the Tiber Island as the result of crops tossed into the River when it was low, after which the pile of debris gradually accumulated silt from the river to form an island.⁷⁷ This story admittedly reflects a lack of scientific expertise, but still displays the Romans' awareness of the Tiber's sediment bedload, which could have contributed to the formation of the river island.⁷⁸ Later Romans would have been keenly aware of the force of silting, especially with respect to harbor installations at the mouth of the Tiber.⁷⁹ Every flood, for that matter, would have deposited sediment as well as other debris in the affected parts of the city. The extant literary record, therefore, reflects a remarkable amount of ecological awareness, including the ancients' sophisticated appreciation for the mutability of the landscape.

⁷⁵ Brocchi 1820, "La carta fisica del suolo di Roma"; Lanciani 1897, fig. 1; Ammerman 2006, 305-307.

⁷⁶ Ammerman 1998, 291; Aldrete 2007, 168; Ammerman et al. 2008, 26; see also Chapter 4.

⁷⁷ Livy 2.5.2-4; Dion. Hal. *Ant. Rom.* 5.13.

⁷⁸ See discussion on the origins of the Tiber Island in Chapter 4.

⁷⁹ Rickman 1988; Oleson 1988. See full discussion in Chapter 5.

Topography of the Forum Boarium

By the Late Republic, when our ancient sources become markedly more abundant and reliable, Rome had already outgrown her original river harbor.⁸⁰ As the extant textual record dates to a period when commercial shipping was directed largely to the *emporium* district in the Testaccio region, Puteoli in the Bay of Naples, and later to Ostia,⁸¹ there is meager historical evidence for activity that once occupied the stretch of lowland between the Capitoline and Palatine hills.⁸² Texts do refer to a number of archaic monuments in the Forum Boarium, including one of the city's oldest roads, the Vicus Iugarius, which traveled from the river harbor through the Forum Boarium on its way to the Forum Romanum (**fig. 6**).⁸³ Although the Republican twin temples discovered at the Sant'Omobono Sanctuary are generally attributed to Fortuna and Mater Matuta,⁸⁴ texts also record the existence of an archaic predecessor built by Servius Tullius, but without a clear association with either goddess.⁸⁵ Looming over the harbor sanctuary in the Forum Boarium, a temple to Rome's supreme god, Jupiter Optimus Maximus, was built on the Capitoline Hill. According to the later literary record, this monumental

⁸⁰ More common are references to a military dockyard (*navalia*) in the Campus Martius. Livy 3.26.7–8; 45.42.12; Platner and Ashby 1929, 358–60; Coarelli 2000. The large *opus incertum* structure in Testaccio (the so-called Porticus Aemilia) has been re-interpreted as dockyards associated with the construction of an *emporium* in the Testaccio region in the second century BCE (Cozza and Tucci 2006). See also discussion in Chapter 5.

⁸¹ D'Arms 1974; Rickman 1988.

⁸² The region of interest to this study is generally referred to as the Forum Boarium. The northern edge of the valley, immediately west of the Capitoline hill, is sometimes distinguished as the Forum Holitorium or "vegetable market" (see fig. 6).

⁸³ Livy 27.37.14; 35.21.6; Richardson 1996, 424; Virgili 1999; Coarelli 1992, 10–18.

⁸⁴ Livy (33.27.4) mentions the existence of temples of Fortuna and Mater Matuta in the Forum Boarium. Both goddesses are especially suitable for a harbor setting, Matuta being the mythological mother of the port god Portunus (Ovid *Fasti* 6.545–548).

⁸⁵ Livy (5.19.6) mentions a temple of Mater Matuta built by Servius Tullius, but without a location. Livy (10.46.14) also describes a temple of Fortuna to be built beside a temple of Servius Tullius, but again lacks a specific location. Ovid (*Fasti* 6.477–480) refers to a temple of Mater Matuta built by Servius Tullius in the Forum Boarium but, in contrast, Dionysius (*Ant. Rom.* 4.27.7) mentions a temple of Fortuna built by Servius Tullius in the Forum Boarium.

construction of the sixth century is ascribed to a vow of Tarquinius Priscus and as a construction of Tarquinius Superbus.⁸⁶

Decades of archaeological research in the region have managed to confirm key parts of the literary record. Coring survey has exposed the gravel shoulder of the Capitoline, which may be interpreted as the natural surface on which the first Vicus Iugarius developed.⁸⁷ That is, an un-paved road at a slightly higher elevation than the valley floor that was appropriate for regular human and cart traffic in this busy part of the city. Furthermore, an Archaic temple, buried 5m below the Republican temples of Fortuna and Mater Matuta, was revealed during excavations at the Sant'Omobono sanctuary and will be discussed at length later in this work. For the purposes of this discussion, little weight need be placed on the details of the kings themselves, but it is worth considering the relative chronology of these building programs, as indicated by the literary record. Although the timeline of the regal period is hopelessly muddled,⁸⁸ Servius Tullius' reign is conventionally associated with the middle decades of the sixth century BCE, while his successor, Tarquinius Superbus ruled until the notorious events of 509 BCE.⁸⁹ Therefore, the relative chronology of these two archaic constructions (as provided by the textual sources) places the first temple at Sant'Omobono in the mid-sixth century, a generation or two earlier than the Capitoline temple. This textual chronology is consistent with archaeological evidence. The ceramic assemblage from recent excavations suggests that the construction of the archaic temple

⁸⁶ Cic. *De re pub.* 2.44; Dion. Hal. *Ant. Rom.* 3.69; Livy 1.55. Plut. *Publ.* 15.1-4 attributes all the credit to Superbus. Tac. *Hist.* 3.72 claims that Priscus also laid the foundations, but that Superbus as well as Servius Tullius built the superstructure. Plin. *Nat. hist.* 35.157 claims that Priscus also summoned the sculptor Vulca for the cult statue. For further reading on the Capitoline Temple: Richardson 1996, 221-224; Tagliamonte 1996; Mura Sommella 2000a; Hopkins 2012b, 2016, 97-125; Potts 2015, 123-124.

⁸⁷ cf. Ammerman 1998, 221; see also discussion in Chapter 5.

⁸⁸ Cornell 1995, 121-126.

⁸⁹ Thomsen 1980, 31.

at Sant'Omobono was completed by the mid-sixth century.⁹⁰ Similarly, excavations of the Capitoline temple's foundation trenches have uncovered pottery dating from the late sixth century.⁹¹ The accuracy of the textual sources on the chronology of temple construction in early Rome is noteworthy. Although the Capitoline Temple would have existed largely in its original form until the structure burned down in 83 BCE,⁹² the Early Archaic temple at Sant'Omobono was buried beneath five meters of sediment, perhaps never seen after the close of the sixth century.⁹³ The memory of its existence, much less that it pre-dated Rome's supreme temple on the Capitoline, is an endorsement for the potential accuracy of some parts of the textual record.

While some details of the archaic topography of the Forum Boarium can be corroborated with archaeological evidence, others remain untested. Most notably, the Ara Maxima of Hercules is cited as one of the earliest and most prominent buildings in the Forum Boarium.⁹⁴ Dionysius describes the altar's poor construction,⁹⁵ perhaps as a veiled reference to the old-fashioned use of mudbrick. In this case, it is difficult to assess the accuracy of the literary record, as scant archaeological evidence (save for a few inscriptions) has been firmly associated with the altar's physical remains.⁹⁶ Lacking more conclusive evidence, scholars locate the Ara Maxima outside

⁹⁰ Diffendale et al. 2016; Brocato and Terrenato 2017.

⁹¹ Mura Sommella 2000a.

⁹² The Capitoline Temple would have experienced regular upkeep and embellishment throughout the Republic (cf. Livy 10.23.12; 40.51.3; Plin. *Nat. hist.* 36.61; 33.18), but there is no literary or archaeological evidence to suggest there were any major reconstructions before the temple burned down in 83 BCE. Therefore, it may be possible to argue that the Temple of Jupiter Optimus Maximus would have maintained its archaic construction (mudbrick walls with a timber and terracotta superstructure) and, in turn, helped to preserve a memory of its archaic past. See Flower (2008, 79) for further discussion.

⁹³ See Chapter 3 for further discussion on the temple's potential visibility after the early fifth century.

⁹⁴ Livy 1.7.10-11; Verg. *Aen.* 8.27; Tac. *Ann.* 12.24; Coarelli 1992, 61-77; 1996; Richardson 1996, 186-187.

⁹⁵ Dion. Hal. *Ant. Rom.* 1.40.6: τῇ μέντοι κατασκευῇ πολὺ τῆς δόξης ἐστὶ καταδεέστερος.

⁹⁶ Coarelli 1992, 92-103; 2007, 318-319. CIL 6.312-19 = ILS 3402-9.

the Circus Maximus⁹⁷ and have tentatively associated it with the remains of a stone structure exposed under the church of S. Maria in Cosmedin.⁹⁸

Writing in the first century BCE, the antiquarian Varro states that the Temple (*aedes*) of Portunus exists *in portu Tiberino*.⁹⁹ As most scholars agree that the iconic temple on the north side of the Piazza della Bocca della Verità should be attributed to the god Portunus,¹⁰⁰ it has been assumed that the original harbor of Rome was located immediately north of the temple, beneath the modern Palazzo dell'Anagrafe (**fig. 7**). Although there is general scholarly consensus on the location of the city's original river harbor,¹⁰¹ reconstructions of early port infrastructure and the timeline for its development have been conjectural to this point. Filippo Coarelli has argued for the reconstruction of the "Portus Tiberinus" in the area north of the Temple of Portunus and south of the church of San Nicola in Carcere (**fig. 8**). Drawing from the textual record, he credits Servius Tullius with the construction of the harbor in the sixth century, as well as the sanctuaries of Fortuna, Mater Matuta, and Portunus.¹⁰² In a series of sketches from 1989 published in *Il Viver Quotidiano in Roma Antica*, Giovanni Ioppolo positions the Archaic temple from Sant'Omobono directly on the bank of the river (**figg. 9, 10**), a rather precarious position for a mudbrick temple.¹⁰³ Lorenzo Quilici provides the most fanciful reconstruction of the harbor (**fig. 11**). Built in 1994, his plastic model of archaic Rome was once

⁹⁷ Servius *ad Aen.* 8.269: *post ianuas Circi Maximi*. See fig. 6.

⁹⁸ Tolotti 1992.

⁹⁹ Varro *Ling.* 6.19; Colini 1980, 44-6.

¹⁰⁰ Platner and Ashby 1929, 430-31; Colini and Buzzetti 1986b; Richardson 1992, 320; Buzzetti 1999a; Coarelli 2007, 315-318. The temple exists today in its first century BCE form. Excavations have exposed the podium of an earlier phase of the structure, which is 5m tall and was erected on the floodplain surface around 6masl; this phase dates to the late fourth or early third century BCE (Colini and Buzzetti 1986b, 9-13, Ruggiero 1991/92, 265; Adam 1994, 49).

¹⁰¹ Platner and Ashby 1929, 430-31; Cressedi 1949/51, 53; Colini 1980, 45; Colini and Buzzetti 1986a; Richardson 1996, 320; Buzzetti 1999b. Location confirmed by this project, see full discussion in Chapters 4 and 5.

¹⁰² Coarelli 1981; 1988; 1992, 23-25, 215-221; 2007, 307-308.

¹⁰³ *Il Viver Quotidiano in Roma Arcaica* 1989, fig. 3, tav. 1.

on display at the Museo della Civiltà Romana and depicts an artificial and regularized harbor with ample docking space for boats set back from the river.¹⁰⁴ A permanent port equipped with regularized dockyards, as portrayed by Quilici, is not a realistic reconstruction of the region in the pre-Republican era.¹⁰⁵ Specialized harbor infrastructure on a large scale would have likely required the use of hydraulic concrete, a technology not available in Rome until the second century BCE.¹⁰⁶

Floods and their effects

Examining the impact of floods in greater depth, textual sources on Rome report 33 different flood events, dating from 414 BCE to 398 CE.¹⁰⁷ Livy alone describes eight floods of the Tiber. There is no doubt that floods have plagued Rome since the ancient period and continued to do so well into the modern period (**fig. 12**), until the construction of massive embankment walls along both sides of the Tiber in 1875-1925 (**fig. 7**).¹⁰⁸ The textual record provides ample data on floods in the Republican and Imperial periods, including the damaging effects on the city's inhabitants and infrastructure. The most flood-prone regions naturally were those in the river valley close to the Tiber banks. Although the majority of these accounts do not specify the regions of the city that were affected, there is reference to floodwaters in the Campus

¹⁰⁴ On the plastic model, see Quilici 1995; D'Amato 1997.

¹⁰⁵ cf. Blackmann 1982, 90-4; Purcell 1996, 268-69.

¹⁰⁶ Mogetta 2015; see also discussion in Chapter 5.

¹⁰⁷ This is in addition to the mythical flood that deposited the infant twin brothers at the base of the Palatine (see above), described by Fabius Pictor and preserved in Dion. Hal. *Ant. Rom.* 1.79.1; Cornell *FRHist* II.53; Ovid *Fasti* 2.390; Varro, *Ling.* 5.54; Livy 1.4-7; Plut. *Rom.* 3-10. See Aldrete (2007, 10-50) for further discussion.

¹⁰⁸ The city still experiences the occasional flood, but this is caused by problems with the modern drainage system, rather than overbank floods of the Tiber. See Aldrete 2007, 241-252 for further discussion.

Martius,¹⁰⁹ Forum Romanum,¹¹⁰ Circus Maximus,¹¹¹ and more importantly for this study, the Forum Boarium.¹¹² In addition, there are accounts of extreme floods affecting higher elevations (fig. 13).¹¹³

The most common difficulty related to inundations of the Tiber, according to the available literary record, was damage to urban infrastructure.¹¹⁴ Some sources report vaguely about building collapses,¹¹⁵ while others specifically identify damage to domestic,¹¹⁶ commercial,¹¹⁷ or religious structures.¹¹⁸ Interestingly, some examples provide description of damaged construction material, including mudbrick and timber,¹¹⁹ whereas other accounts describe stagnant water undermining building foundations.¹²⁰ Bridges also commonly fell victim to the force of floodwaters.¹²¹ Concerning effects in Rome's hinterland, there are several references to the destruction of farmhouses and cattle being swept away in floodwaters.¹²²

In addition to the toll on urban and agricultural infrastructure, the textual record also provides some indication of the human cost. Death or injury as a result of flooding is repeatedly

¹⁰⁹ Livy 38.28.4; Ovid *Fasti* 3.519-520. See Aldrete 2007, 79 on flooding in Ovid.

¹¹⁰ Hor. *Carm.* 1.2.1.13-20.

¹¹¹ Livy 7.3.2; 30.38.10-12; Dio 56.27.4; Ovid *Fasti* 2.389-392. See Aldrete 2007, 35 on flooding in Ovid.

¹¹² This is described as the area around the Porta Flumentana, which was a gate in the Servian walls opening onto the Tiber from the Forum Boarium. Livy 35.9.2-3; 35.21.5-6.

¹¹³ Dio 39.61.1-2; Tac. *Hist.* 1.86; Claud. *De Bel. Gild.* 41-43.

¹¹⁴ Aldrete 2007, 102-118.

¹¹⁵ Tac. *Ann.* 1.76; Suet. *Otho* 8.3.

¹¹⁶ Houses or apartments: Dio 39.61-1-2; 37.58.2-4; Tac. *Hist.* 1.86; Pliny, *Epist.* 8.17.

¹¹⁷ Shops: Cic. *Ad Quint. fr.* 3.7.1.

¹¹⁸ Temples or shrines: Hor. *Carm.* 1.2.1.13-20; Sex. Aur. Victor *Epit.* 13.

¹¹⁹ Timber: Dio 37.58.2-4; Tac. *Hist.* 1.86; Dio 50.8.3. The mention of brick is presumably mudbrick: Dio 39.61.1-2, αἱ τε οὖν οἰκίαι ἐκ πλίνθων γὰρ συνωκοδομημέναι.

¹²⁰ Aug. *De Civ. Dei* 3.18; Tac. *Hist.* 1.86.

¹²¹ Livy 35.21.5-6; Dio 37.58.2-4; 53.33.5; 55.22.3; Tac. *Hist.* 1.86. See for example an inscription from the Pons Fabricus (*CIL* 6.1305 = *ILS* 5892), which records a restoration project undertaken in the year of a flood (23 BCE) by the consuls Q. Lepidus and M. Lollius. Aldrete 2007, 19, 24, 123-128. For general discussion of rebuilding inscriptions as a result of natural disasters, see Thomas and Witschel 1992.

¹²² Livy 4.49.2-3; 24.9.9; 35.21.5-6; Pliny, *Epist.* 8.17; Dio 39.61.1-2.

recounted.¹²³ Compounding the immediate adverse effects, Romans struggled with famine in the wake of some flood events.¹²⁴ While discussing a flood in 69 CE, Plutarch specifically mentions the submerged grain market, which may be interpreted as a reference to *horrea* in the Forum Boarium (see **fig. 6**).¹²⁵ Finally, there is recognition of long-term health problems in the lowlands. Although the texts do not explicitly associate floods as causative factors, issues of salubriousness could reflect poor drainage or stagnant water following inundation.¹²⁶

When considered together, these texts may be perceived in two general ways: first, as accurate depictions of the destruction caused by floods, or second, as biased reflections of the most significant damage worthy of memory. The more conservative assessment would adhere to the latter, as it is reasonable to conclude that the record omits numerous less impressive floods and a variety of destruction details within the city. In other words, these textual references cannot be seen as a comprehensive list of floods and their effects in Rome, but do include select pieces of accurate information on the effects of floods in the city from the Late Republican Period.

Ultimately, literary sources help illuminate the recurrent problems with flooding in Rome throughout the ancient period. Inundations are depicted as having broad impact on the city's residents, including the loss of both public and private property.¹²⁷ The majority of the historical sources were not only familiar with the Tiber's destructive force, but also indicate that the Romans had at least a basic understanding of fluvial dynamics, especially with regard to the seasonality of flooding and the effect of heavy rain in the region causing the river to swell.¹²⁸

¹²³ Livy 35.21.5-6; Dio 37.58.2-4; 39.61.1-2; Tac. *Ann.* 1.76; Pliny, *Epist.* 8.17.

¹²⁴ Tac. *Hist.* 1.86; Am. Mar. 29.6.17-18.

¹²⁵ Plut. *Otho* 4.5; Coarelli 1992, 400; 2007, 315-316; Aldrete 2007, 38.

¹²⁶ Livy 5.48.1; Cato *De agr.* 1.3; Columella *RR* 1.5.3. See also Cic. *De re pub.* 2.11, discussed above. See Aldrete 2007, 118-123 for further discussion.

¹²⁷ Aldrete 2007, 97-102.

¹²⁸ Plut. *Numa* 22.4; Dio 39.61.1-2; 57.14.7-8; Tac. *Ann.* 1.76; Pliny *Epist.* 8.17; Am. Mar. 29.6.17.

Moreover, it is likely that at least some of these authors—and much of their contemporary audience, for that matter—would have personally witnessed a flood event at Rome in their own lifetimes, making their accounts of flood events even more credible.¹²⁹

Human response to flooding

In addition to descriptions of floods, the textual record also provides a glimpse, albeit limited, into the Romans' response to these natural disasters. Like fires and earthquakes, floods were typically interpreted as signs from the gods. Although the texts usually imply that these natural disasters were negative portents or even means of divine punishment,¹³⁰ a passage from Cassius Dio is an odd exception to this norm. He claims that soothsayers interpreted a flood in 27 BCE, the same year he receives the name Augustus, as a sign of Octavian's rise to power.¹³¹ Despite the likelihood that this construct is the result of Augustan propaganda, it is interesting to note this unique instance of a flood being portrayed in a positive light. The lengths to which it seems Octavian went to emphasize the positive aspects of an inundation further demonstrates that floods were regarded with widespread negativity.

Typically, floods would wreak havoc in the city and force Rome's inhabitants to react accordingly. Livy reports that efforts to combat the effects of inundation began as early as the regal period. Specifically, the Cloaca Maxima was installed in order to permit drainage of the Velabrum valley (see **fig. 6**).¹³² This sewer, which was enlarged and maintained throughout the

¹²⁹ Cic., *Ad Quint. fr.* 3.7.1 on the flood of 54 BCE; Hor. *Carm.* 1.2.1-20 on the flood of 44 BCE; Pliny *Epist.* 8.17 on a flood during the reign of Trajan; possibly Tac. *Hist.* 1.86 on the flood of 69 CE.

¹³⁰ Livy 4.49.2-3; 7.3.2; Dio 57.14.7-8; 30.38.10-12; Plut. *Otho* 4.5; Tac. *Hist.* 1.86. Additionally, Tacitus (*Ann.* 1.76) includes a reference to consulting the Sibylline Books following the flood of 15 CE. See Aldrete 2007, 219-221 for further discussion.

¹³¹ Dio 53.20.1.

¹³² Livy 1.38.6; 1.56.2; Plin. *Nat. hist.* 36.24; Dion. Hal. *Ant. Rom.* 3.67.5; 4.44.1. For a discussion on the Cloaca's original form as an open-air canal: Hopkins 2007; 2012a; also Chapter 5.

ancient period, still exists today.¹³³ Drainage through sewers, canals, and spillways were employed as mechanisms to aid flood control and recovery; Julius Caesar even proposed using such methods to re-route the Tiber away from the city altogether.¹³⁴ Vitruvius praises the potential of cities built in swampland once channels are built to allow drainage.¹³⁵ When floodwaters were especially high or enduring, the Romans were prepared to navigate the city by boat until the waters receded, utilizing watercraft to supply food in the wake of flood-related famine.¹³⁶ Eventually, flood management became bureaucratized, as there are several literary and epigraphic references to political offices and appointees tasked with the maintenance of the Tiber.¹³⁷ Despite these efforts at flood prevention and management, Romans of the ancient period never completely succeeded in taming the Tiber,¹³⁸ only in cleaning up after the river overran its banks.

Utilizing historical sources in environmental reconstruction: a moderate positivist approach

As the three case studies above have highlighted, archaeological evidence has substantiated significant aspects of the literary record with respect to environmental and topographic details. Ancient sources get at least portions of the story right, including details of

¹³³ Dio 49.43.10; Plin. *Nat. hist.* 36.24; Mocchegiani Carpano 1984; Bauer 1989.

¹³⁴ Pliny *Epist.* 8.17; Suet. *Caes.* 44; Plut. *Caes.* 58; Lagunes 2004, 117-128; Aldrete 2007, 167-178, 181-199.

¹³⁵ Vitr. 1.4.11; Boëthius 1978, 35.

¹³⁶ Dio 53.20.1; 53.33.5; 54.25.2; 57.14.7-8; 58.26.5; Zonaras 11.3; Claud. *De Bel. Gild.* 41-43; Prop. 4.9. See Am. Mar. 29.6.17-18 on the use of boats to supply food.

¹³⁷ Tac. *Ann.* 1.76; Dio 57.14.7-8; Suet. *Aug.* 37; *CIL* 6.31540 = *ILS* 5922; *CIL* 14.5320. See discussion in Aldrete 2007, 198-203.

¹³⁸ See Aldrete (2007, 232-239) for an intriguing discussion of the Romans' failure to protect their capital city from floods. There is considerable anthropological discourse on human adaptation to environmental hazards, including a cultural response focused on risk acceptance and rebuilding rather than prevention; this will be discussed in greater depth in my next chapter.

the pre-urban landscape and the city's archaic building program. Therefore, texts on early Rome may be deemed applicable, depending on the research question. The skepticism displayed by T.P. Wiseman and other members of his camp is too extreme, but T.J. Cornell's willingness to accept minute details is also misguided. Instead, a more discerning positivist approach is most appropriate for my research project. As the skeptics demand, it is sensible to dismiss details of historical figures (such as Aeneas, Romulus, etc.), but to be more confident in the general outline of early Roman history portrayed in the textual record.

The topic of monarchy serves as an illustrative example. Discovered during Giacomo Boni's excavations in the Comitium in 1899, the *lapis niger* inscription includes a reference to a *rex* (in an archaic form of the dative case) and has been dated to the second quarter of the sixth century BCE.¹³⁹ Coarelli argues that the inscription likely alludes to an actual monarchy, and not simply the priestly office of the *rex sacrorum*, who remained as a symbolic king into the republican era.¹⁴⁰ Although the role of kings at Rome remains an open question, this fortuitous discovery nonetheless adds further credence to the reliability of the record on Archaic Rome. We have physical proof of some regal figure in Rome, thus helping to lift this period from the realm of myth. Even so, scholars may choose to accept the monarchy as authentic while justifiably dismissing many biographical details of Rome's seven kings as inventions of later historians.¹⁴¹

A moderate positivist approach, as I employ, embraces literary sources as having the potential to preserve the general picture or memory of Rome's early history (with regard to broad social, political, commercial, topographical, or environmental themes), but largely discounts the details as the result of later embellishment. The intended objective here is not to employ the texts

¹³⁹ *CIL* 1.2.1 = *ILS* 4913 = *IILRP* 3.

¹⁴⁰ Coarelli 2007, 53-55; cf. Lanciani 1902, 1-30; Pais 1905, 15-42; Cornell 1995, 94-95; Smith 1996, 167, 185-186; Wiseman 2008, 306.

¹⁴¹ Momigliano 1963, 98, 106-107; 1989, 90.

as indisputable fact, but simply to redeem the historical record as a potential source of information, which may prove analogous to, or fill gaps in, the archaeological record. Ancient sources must be considered with caution as errors and biases still lurk in the realm of generalities, but the data need not be categorically discounted from the outset.

For the specific goals of this project, the textual record can preserve authentic information from Early Rome in two ways. First, literary sources may include accurate portrayals of the topography and environment in the early city. As demonstrated in the case studies above, the memory of Rome's archaic topography is indeed credible, but should be confirmed with archaeological evidence whenever possible. The existence of inaccuracies in the texts, such as the suggestion that the valleys of archaic Rome were permanent swamps,¹⁴² reflects the Romans' limited awareness of their pre-urban landscape. Instead of using this shortcoming as further justification to reject the historical record of Early Rome, an awareness of the ancients' perceptions can vindicate and explicate inaccuracies or misrepresentations in the texts.¹⁴³ Second, texts on the environment in later periods of Roman history may be applied as analogous to the early city. There is a peak in flood records from 200 BCE to 200 CE. This observation does not actually presume an increase in flood frequency, but rather corresponds with the best documented period in Roman history.¹⁴⁴ It is possible to capitalize on this bias by giving records from Republican and Imperial Rome broader applicability. Extrapolating from these more complete records, it is possible to flesh out the scantier documentation of earlier

¹⁴² Ovid, *Fasti* 6.395-417; Varro, *Ling.* 5.43-44; Prop. 4.9.5; Plut. *Rom.* 5.5. See discussion above.

¹⁴³ See above for the discussion of the swampy description of the valleys in the archaic period, and how this has been refuted with geological evidence.

¹⁴⁴ Aldrete 2007, 14; 78. Floods are typically mentioned in sources only when they can be associated with significant events or interpreted as portents.

periods. Specifically, the dynamics and effects of floods described in these accounts may be extended as general comparanda for such events in the prehistoric period.

As we proceed, some basic assumptions must be met. Although the urban topography and environment of Rome changed dramatically over time, there remain certain ecological consistencies that allow analogous connections to be made between early and later Rome. For example, the nature of flooding in Rome (i.e., seasonality, frequency, magnitude, etc.) would have been relatively consistent throughout the ancient period. As the city grew and the ground level rose, floods increased proportionately, becoming more severe and disruptive.¹⁴⁵ The progressive strength of the river is the result of numerous environmental variables from across the entire Tiber drainage basin. Likely as early as the sixth century BCE, deforestation and intensive agriculture throughout the Tiber River Valley increased the effects of erosion, which would have directly compounded the frequency and severity of floods by causing an increase in surface runoff and the volume of water entering the river system.¹⁴⁶ Moreover, heavily developed urban environments with an abundance of paved surfaces can further exacerbate surface water runoff and the intensity of floods.¹⁴⁷ Thus, the urbanization process at Rome and other cities in the region contributed commensurately to an increase in the adverse consequences of flooding. As Rome grew and Romans endeavored to protect their city from floods, the Tiber responded in kind.

In addition to the nature of flooding, the effects of floods on built infrastructure at Rome can be understood as relatively consistent from the Archaic period through the Late Republic.

¹⁴⁵ Aldrete 2007, 88.

¹⁴⁶ Delano Smith 1979, 278-279; Hughes and Thirgood 1982, 67; Aldrete 2007, 74. There is considerable scholarship on the interrelated effects of deforestation, agriculture, erosion, and flooding, which is discussed in greater depth in Chapter 2. For general reference: Brown and Ellis 1995; Brown 1997, 192-218; O'Sullivan et al. 2008; see also Chapter 5.

¹⁴⁷ Aldrete 2007, 88.

Before the invention of concrete in the mid-second century BCE,¹⁴⁸ archaic building materials (mudbrick, timber, and terracotta) dominated architecture in the city for several centuries.¹⁴⁹ Although the use of stone for monumental architecture gradually prevailed, there is little doubt that a vast majority of houses and shops continued to be built from such materials well into the Republican period; indeed, there is ample basis for the adage about Augustus inheriting a city of brick.¹⁵⁰ This consistency in building materials over several centuries would have meant that many generations of Romans were similarly susceptible to the Tiber's floodwaters. In other words, it is reasonable to assume that Romans of the Republic who endured floods shared an experience similar to that of their archaic ancestors, specifically the sudden destruction of mudbrick buildings and the need to rebuild quickly with these relatively inexpensive materials. Therefore, the historical record of flooding can be employed as general comparanda for, but not direct indications of, similar events in earlier periods.

Although it is worth acknowledging the consistencies in the force and result of floods, these observations are not intended to suggest a perfect correlation between the Archaic and Republican periods. There are limitations to the application of historical texts to Early Rome, which must be taken into consideration. For instance, the analogy becomes less valid as technology advances (especially with the invention and widespread use of concrete) and as the socio-political system becomes capable of adaptation (e.g., with larger civic contribution to recovery efforts), which make floods less menacing. It is quite likely that recovery would have

¹⁴⁸ Mogetta 2015.

¹⁴⁹ In the first century BCE, Vitruvius (2.8.16) still praises mudbrick architecture. For a general reference on archaic architecture and construction materials: Boëthius 1978; Cifani 2008; Potts 2015; Hopkins 2016.

¹⁵⁰ Suet. *Aug.* 28; Boëthius 1978, 35; Favro 2005 for further discussion of the city before Augustus' tremendous building program; cf. Flower 2008. Also, Cassius Dio (39.61.1-2) mentions the destruction of mudbrick homes in a flood in 54 BCE.

been quicker in later periods, due to improved drainage systems as well as greater civic oversight. Moreover, once stronger construction materials dominated the cityscape, the effects of floods on urban infrastructure would have diminished to a degree.

Despite these limitations, there is considerable support for the applicability of the literary record among scholars interested in the environment of Early Rome. As demonstrated above, ancient sources can provide reasonably accurate topographical and environmental descriptions of the early city, which can be tested in the archaeological record, as well as provide later accounts of environmental conditions that may be used as analogies in prehistoric contexts. The picture provided by the literary record is an interesting but patchy one, leaving numerous questions open for new research.

Conclusions: Interweaving literary, archaeological, and environmental evidence on Early Rome

The survey of literature, both modern and ancient, presented here serves as a helpful foundation that also begins to illustrate the ways in which the archaeological record can test, and even prove accurate, details of the literary record on early Rome. My philosophy is deceptively simple: consider and evaluate all potential data sets. Archaeologists should not ignore textual evidence when it is available, nor should they take it unquestioningly as fact and put excessive weight on the details it provides. The literary record has shaped centuries of modern research on Rome, and it is instructive for archaeologists to engage with this broader field of historical scholarship. Prominent mid-20th century historian Arnaldo Momigliano saw the benefit of such cross-disciplinary thinking, particularly when it came to the convoluted subject of early Rome:

“Through the words of Livy and Dionysius the modern historian is in direct contact with what generation after generation of Romans thought about

themselves. The pure archaeologist cannot rely on the living memory: he has to guess and to infer, very often by analogy. He has to deduce the thoughts from the objects, the individuals from the collective products. [...] Where there is a literary tradition it is a safer guide to a past civilization than archaeology alone. But of course archaeology can act as an excellent control of a literary tradition. The archaeologists can check the truth of many stories by a direct approach which by definition is denied to the critic of literary texts. [...] As early Rome is the ideal place to combine archaeological exploration and source criticism, the study of archaic Rome remains an ideal school of historical method.”¹⁵¹

When fresh methods from environmental sciences are combined with the conventional archaeological and literary approaches to Early Rome, there are new research opportunities to incorporate precise data on the pre-urban environment, including information about the changing position of the Tiber River as well as the hydrology associated with flood events. Ancient sources may prove accurate and beneficial even in prehistoric research, as is the case here, when the literary record can provide insight into ecological phenomena not visible in the archaeological record, such as the human perception of the environment and environmental hazards. Environmental reconstructions alone are insufficient. In order to comprehend the higher-level cultural processes at work, the fundamental aim is to understand human-environment interaction, and ancient sources provide an invaluable human voice in that relationship.

Ecological research questions and investigations help to illuminate the natural benefits and challenges facing the early inhabitants of Rome, thereby providing new perspectives on the urbanization process, particularly regarding patterns of habitation. Although conventional research on prehistoric Rome has primarily been focused on the hilltops,¹⁵² especially the

¹⁵¹ Momigliano 1963, 107-108.

¹⁵² This research bias is entirely explicable. First, scholars typically assume that urban growth across central Italy during the late second and early first millennia was focused heavily on the hilltops (Cazzella et al. 2007, 808; Alessandri 2013, 15, 29-53; Fulminante 2014, 175-177). Second, when preserved, early habitation levels in Rome are more accessible on the hilltops of Rome than in the valleys, where they are buried beneath several meters of fill deposits (see Chapter 3).

Capitoline and Palatine, new evidence from the lowlands is beginning to enhance and even revise the traditional picture. A desire to occupy and build in their valleys without the hazard of seasonal flooding would lead the early inhabitants of Rome to contend with their environment at the very onset of the urbanization process. Beginning in the late seventh or early sixth centuries BCE, the Romans invested in a variety of projects across the nascent city including reclamation, terracing, and quarrying, which transformed the natural landscape and facilitated urban expansion.¹⁵³ The planning and execution of these endeavors would have required the mobilization of a large labor pool, substantial material resources, the delineation of public space, and a degree of technological expertise. According to ancient tradition, these civic projects—well-documented in the archaeological record, in part due to discoveries of the present project—are supposed to have taken place at a time when Rome was ruled by an Etruscan king and inhabited by a mixed group of native and foreign settlers.¹⁵⁴ Although the details of these individuals are lost or legend, their impact on the landscape was indelible. My project demonstrates how a reliable reconstruction of environmental impact and flood mitigation efforts at Rome can elucidate the complexities of socio-political developments even in a prehistoric context.

¹⁵³ Ammerman 2006, 299-300.

¹⁵⁴ Cornell 1995, 122-130, 156-163.

Chapter 2

Human Ecology Theory: elucidating past human-environment interactions in river valleys

Most major cities were erected on water, whether the bank of a river or on the coast of a lake or sea. In the pre-modern world, water provided crucial access to natural resources and commerce, which made settlements possible and potentially prosperous. As settings of human habitation and urban growth, river valleys evolve over the millennia as a result of various natural forces and the greatest agent of geological change: human beings. By exploiting and manipulating their landscape, urban dwellers adapt to and physically transform riverine environments. This complex, reciprocal human-environment relationship underlies the early history of a society's urban growth, and a record of this ecological process can be preserved in river valleys, which collect sediment and materials washed downslope from the surrounding landscape. Claudio Vita-Finzi was one of the first scholars to recognize the historical significance of such valley fills. In his 1969 monograph, *Mediterranean Valleys*, he evaluates both natural and anthropic causes of geological change in riverine systems, in an attempt to “isolate the effects of human activity on the nature and rate of erosion and deposition.”¹⁵⁵ Vita-Finzi realized that riverine landscapes are constantly changing and readily susceptible to the growth of cities, so that valley fills can be studied as the physical product of complex, diachronic human-environment interactions on the surrounding landscape.

¹⁵⁵ Vita-Finzi 1969, 3.

As modern settings often do not directly correspond to past environments (paleoenvironments), it is imperative to draw upon a number of disciplines in order to study the past—and often no longer existing—biological and geological features of a given local. Any investigation of paleoenvironments poses several challenges. First, there is limited visibility of paleoenvironment data, which are often buried beneath later geological and archaeological layers.¹⁵⁶ Additionally, there must be an understanding of complex taphonomic processes that shape the landscape at multiple temporal and spatial scales.¹⁵⁷ As any environment is a product of continual and on-going transformational processes, these forces have the potential to obscure or even obliterate pre-existing features of the landscape.¹⁵⁸ These challenges demand a cross-disciplinary approach that involves contributions from both the natural and social sciences, a necessity which can lead to secondary intellectual and logistical obstacles to ecological research in past contexts.¹⁵⁹

Towards an understanding of human-environment relationships

Attempts to define the role of the environment in anthropological discourse originated in the deterministic movement, which was initially advanced by Gordon Childe. Shaping scholarship in the early to mid-20th century, “environmental determinism” is a theory that establishes a direct causal link between environmental/climatic change and major cultural changes. Most notably, Childe proposed climate-based explanations for the origin of agriculture.¹⁶⁰ Developments in anthropological theory from the 1960s, however, began to

¹⁵⁶ Stein 1992, 206. On accessing Rome’s deeply buried paleolandscapes, see Chapter 3.

¹⁵⁷ Stein 1985; Schiffer 1987; Stein 2001; Zedeño 2000, 110.

¹⁵⁸ Waters and Kuehn 1996.

¹⁵⁹ Dincauze 2000, 23, 502-503.

¹⁶⁰ Childe 1928.

expose the limitations of this deterministic model, which greatly deemphasizes human agency and the variety of possible adaptive responses. In reality, many variables contribute to the nuances of both cultural change, so that environmental stress alone is typically an insufficient explanation for any complicated cultural phenomenon and process.¹⁶¹

A major proponent of human ecology theory, Karl Butzer articulated many of the foundational premises of the field in his 1982 monograph. Butzer emphasized the reciprocal nature of human-environment interactions as well as the importance of a multivariate systems approach that recognizes each as capable of acting upon and influencing the other.¹⁶² The environment is not simply a static background setting for cultural activity,¹⁶³ but a fluid system with complex physical, biological, and social characteristics,¹⁶⁴ all of which indirectly and directly influence the behavior of humans on the landscape. The environment does not determine culture or history, but it provides opportunities and limitations for certain social processes. Humans, as one component of a complex ecosystem, simultaneously shape and are shaped by their environments, a fact that makes human ecology theory an essential component to historical studies.

Environmental histories require a diachronic and processual approach in order to properly distinguish the multi-variate cause and effects of landscape change. As the result of both natural and man-made forces, landscape transformation can occur quickly or slowly, frequently or infrequently, and in local, regional, or global contexts. A volcanic eruption is typically a quick, but infrequent event with primarily local consequences. An earthquake, in contrast, is quick,

¹⁶¹ cf. Rapp and Hill 2006, 187; Terrenato 2011, 241.

¹⁶² Butzer 1982, 14-32. This was nicely in line with the aims of the processual movement in anthropological theory, cf. Binford 1965; Renfrew 1972, 19-23; Kirch 1980.

¹⁶³ Ingold 1993, 152.

¹⁶⁴ Dincauze 2000, 17.

semi-frequent, and has a regional impact. Climatic shifts, on the other hand, are relatively slow processes, but have a global impact. Given the inherent dynamism of the environment, no single landscape can readily be identified as “natural, normal, or original.” Instead, environmental and topographical changes must be understood in relative terms, as a shift from one state to another.

In addition to the natural forces that shape landscapes, human intervention is a major cause of environmental change. Because this is a broad topic with many modern implications, it is worth delineating some categories of human activities that resulted in landscape transformation in a pre-modern context:

1. resource exploitation and depletion (e.g. hunting, deforestation, mining)
2. domestication and pastoralism, which led to diversification of both faunal and floral species
3. intensive agriculture, which included aspects of hydraulic engineering and conversion of feral land to farms
4. urbanization, which caused numerous intrusions on a local environment, including an increase in paved surfaces, trash disposal, population density, etc.
5. trade and migration, which introduced foreign species and materials to new regions

This succinct enumeration serves only to illustrate the varied impact of early human activity on the environment, ranging from major to minor modifications with both positive and negative consequences for the ecological system. Recent geological and archaeological research has consistently illustrated the effects of anthropic activity and land-use changes.¹⁶⁵ Urban growth leads to an increase in paved areas and surface runoff, which exacerbates flooding and erosion.¹⁶⁶ Deforestation for building materials and fuel as well as the conversion of feral land for the

¹⁶⁵ Marsh 1867, 3-8; Stoddart 1969, 47; Bell 1982; Bintliff 1977, 89; Andel et al. 1986; Brown 1997, 313; Brown and Ellis 1995; Lewis et al. 1995; Horden and Purcell 2000, 59-61, 308; Brown 2002; Butzer 2005, 1795; Runnels 2000; Pope and Andel 1984.

¹⁶⁶ Dimpleby 1976; Meiggs 1982, 246, 371-403; Butzer 2005; Rapp and Hill 2006, 192-194; Menotti 2002, 239; Runnels 2000.

purposes of intensive agriculture further perpetuate problems with erosion.¹⁶⁷ As landscapes are delicate ecosystems influenced by a complex network of variables, it can be difficult to isolate cause-effect relationships, particularly in past contexts.¹⁶⁸ It is worth highlighting, however, a general trend of interest here. Human activity on the landscape (especially the concurrent rise of urban, deforestation, agricultural pursuits) intensifies erosion, sedimentation and flooding over an extended timeline, as was the case during the *longue durée* of land-use change and urbanization in the Mediterranean in the late second and first millennia BCE.¹⁶⁹

Cultural responses to environmental stress

In addition to explorations of natural and human-caused landscape change, a parallel scholarly discussion has evolved around questions of cultural response to environmental change and stress.¹⁷⁰ Most environmental pressures (such as earthquakes, draughts, floods, volcanic eruptions, etc.) fall on a spectrum of severity and frequency. Natural disasters that occur on a seasonal basis or every few years, which a person will definitely experience in his/her lifetime, can be contrasted with infrequent events, which occur once a century or even a millennium, making it less likely that a person will confront the stress in his/her lifetime.¹⁷¹ Although factors such as magnitude and frequency are integral for understanding the impact of a given environmental stress, they do not serve as a direct indicator of cultural response.¹⁷²

¹⁶⁷ Dimbleby 1976; Bintliff 1977, 103-106; Hunt and Gilbertson 1995, 167; Barker and Hunt 1995, 155-156; Butzer 2005, 1775-6.

¹⁶⁸ Butzer 2005.

¹⁶⁹ cf. Dimbleby 1976, 204; Runnels 2000, 17-18.

¹⁷⁰ e.g., Sewell 1969; Bawden and Reycraft 2000; Torrence and Grattan 2002a.

¹⁷¹ For example, Californians experience frequent, minor tremors while awaiting a major shift in the San Andreas Fault, the so-called “big one.”

¹⁷² Torrence and Grattan 2002b, 11-12.

Here “adaptation” is defined as a human’s or culture’s minor or major adjustments to perceived environmental threats in an attempt to sustain stability or maximize socio-economic benefits.¹⁷³ Perception is key to understanding how and why a culture might adapt to environmental pressure.¹⁷⁴ As people can only react to threats they perceive, infrequent or low magnitude environmental stress may not be recognized or necessitate adaptation without modern record-keeping or scientific analysis.¹⁷⁵ Therefore, such pressures are unlikely causes of adaptive responses in the pre-modern world, although a culture might change (or cease to exist) following an unusual but major disaster. On the other hand, frequent events are more likely to receive attention,¹⁷⁶ as they could be recognized in a single lifespan or preserved within the memory of a few generations. Regularly occurring floods, draughts, resource depletion, and mild earthquakes may elicit an adaptive response, while rare catastrophes (such as volcanic eruptions and massive earthquakes) may be less likely to prompt adaptive efforts.

Even if a given hazard is indeed perceived, this does not guarantee that appropriate adaptive actions are taken. In other words, perception alone does not necessarily generate an adaptive response.¹⁷⁷ Cultural adaptation to environmental stress should be understood as the result of a variety of stimuli, both exogenous and endogenous.¹⁷⁸ For example, resource depletion (exogenous stimulus) may be perceived, but not trigger an adaptive response until there is sufficient population growth (endogenous stimulus). Additionally, some types of adaptation

¹⁷³ Modified from Butzer 1982, 290. See also Kirch 1980, 103 for a summary of the diverse uses of the term “adaptation.”

¹⁷⁴ Dincauze 2000, 73. For the purposes of this study, relatively slow changes (such as climatic shifts), which cannot be perceived in the pre-modern world, will not be considered here.

¹⁷⁵ Dincauze 2000, 73. For example, a coastal community, which may have no historic knowledge of tsunamis or any ability to predict a future tsunami, will not adapt to this unperceived threat.

¹⁷⁶ Torrence and Grattan 2002b, 12-13.

¹⁷⁷ Sewell 1969, 441.

¹⁷⁸ Butzer 1982, 292; Dincauze 2000, 65-67.

entail technology and/or socio-political cooperation, which require a certain level of civic infrastructure and engineering capabilities. When an environmental stress is indeed perceived and adaptive measures are taken, the chosen response is illustrative of a community's resource priorities. Regarding features visible in the archaeological record, it may be possible to recognize buildings or locations that received special attention or were transformed in the wake of a disaster. By identifying whether structures were destroyed, abandoned, rebuilt, or redesigned, it is possible to both infer some details about the perceived threat as well as the community's priority for allocating resources in response to that threat.¹⁷⁹

Given the complexity of variables involved in human-environment interaction, it is important to realize that cultural change cannot be adequately explained with mono-causal theories,¹⁸⁰ which was a problematic characteristic of environmental determinism. Instead, the dynamic forces behind complex cultural processes should be integrated within the context of numerous exogenic and endogenic stimuli, including environmental pressure, population growth, technological advancements, access to trade, subsistence advancements, economic specialization, and so forth.¹⁸¹

Human adaptation to floods

Of particular interest here are adaptive responses associated with maintaining a river harbor in the Forum Boarium during the early centuries of urban development at Rome. By exploring the effects of floods in urban environments more generally, it will be easier to

¹⁷⁹ Dawdy 2006.

¹⁸⁰ Brown 1997, 315; Dincauze 2000, 32.

¹⁸¹ cf. Terrenato 2011, 241.

understand and explain how the inhabitants of Rome coped with nuisance flooding, so that they could operate a cult center and commercial port in a flood-prone district.

Riverine floods are the naturally occurring results of rainfall over a regional catchment basin, which collects and drains water into the river. Depending on specific climatic and geographic conditions, floods can occur at various scales of magnitude and frequency, so that events can be described in terms of the 10-year or 100-year flood to denote various levels of normal to extreme events. Although rivers offer numerous advantages to settlement, including access to fresh water and fertile land, recurrent inundations have the potential to endanger settlement activity along rivers. Flood events (with the exception of a flash flood) would have posed little immediate risk to human life, as people could easily escape flood-prone areas once waters started to rise, but there are other immediate consequences: destruction of urban infrastructure; deposition of silt and debris, which requires labor-intensive clean up; and disruption of urban life for days or weeks.¹⁸² Long-term effects in the pre-modern world would also include health issues associated with stagnant water,¹⁸³ decreased food supply resulting from destroyed agricultural land and cattle,¹⁸⁴ and costs associated with extensive rebuilding.

Despite these challenges, floodplains provide numerous incentives for habitation, including easy access to communication and trade routes, water, and fluvial sediments that provide rich minerals for agricultural exploitation in floodplains. A long and extensive global history of human settlement in riverine locations validates the applicability of adaptive

¹⁸² Aldrete 2007, 118, 92-97, 123-128.

¹⁸³ Malaria is a persistent problem in flood-prone regions. Transmitted by mosquitos, which breed in marshy areas, malaria killed on a mass scale prior to the invention of quinine treatment at the beginning of the 20th century. For this reason, the Pontine Marshes and much of the countryside around Rome was notorious for its insalubrity and high-risk for malaria through the 19th century. For further reading, see Snowden 2006, 7-52; cf. Jones 1907, 73; Sallares 2002, 66-68, 204; Dawdy 2002, 723.

¹⁸⁴ cf. Snowden 2006, 9, 15-16.

mechanisms, which allow cultures to thrive in floodplains.¹⁸⁵ Typically, the chosen adaptive response depends on the frequency and severity of floods as well as the socio-political status of a given community. Coordinated, multiple strategies can be deployed in order to minimize inundation and maximize the economic potential of floodplain occupation, including measures of prevention, mitigation, and recovery.

Flood prevention is any effort to control or escape from floods.¹⁸⁶ In the context of the pre-modern world, this includes ritual acts, such as appealing to the gods for protection. More substantially, a settlement may be permanently moved to higher ground.¹⁸⁷ Although this may be a practical solution for a pre-urban society, it was likely a rare option as it forfeits all benefits of floodplain occupation.¹⁸⁸ A more conservative approach would involve seasonal evacuations of people and property from the floodplain,¹⁸⁹ but this is only feasible when flood cycles are predictable. Moreover, such seasonal occupation would limit the amount of permanent infrastructure investment in a floodplain. Finally, hydraulic engineering may be used as a preventative measure for urbanized societies. Embankment walls, dams, reservoirs, and dredging can prevent floods, but such engineering requires a certain level of technological capability and civic oversight.

When flood prevention fails or is simply not a viable option, mitigation can be pursued to reduce the destructive capacity of floods. This can involve architectural investments, including constructions on stilts or podia, or locational choice, such as concentrating structures on natural levees or terraces that are elevated over the lowest parts of the floodplain.¹⁹⁰ Similarly, flood-

¹⁸⁵ Vita-Finzi 1969, 2; Sewell 1969, 431; Brown 1997, 279-303.

¹⁸⁶ Sewell 1969, 428-440.

¹⁸⁷ cf. Snowden 2006, 32.

¹⁸⁸ Brown 1997, 297-300.

¹⁸⁹ cf. Ammerman 1998, 221.

¹⁹⁰ Brown 1997, 36; Ammerman 1990, 634-635; Ammerman 1996, 134-135.

resistant building materials might be employed, so that concrete and stone (rather than mudbrick and timber, for example) become the prevalent building material in floodplains. Land reclamation and extensive drainage systems are a more extreme measure undertaken to raise the ground level and protect against flooding.¹⁹¹ Most of these adaptive mechanisms aimed at mitigation are reasonable options available to proto-urban or small communities despite the need for a basic level of technological expertise and access to manual labor.

When prevention and mitigation do not fully address the threat, recovery plans are utilized. Emergency response can be employed to rebuild and clean up debris after a flood, but any coordinated effort typically requires socio-political management. As a result, the development of emergency response protocol may be related to the establishment of political offices and civic oversight. Such bureaucratic administration may go beyond immediate response to also regulate activity in flood-prone areas.¹⁹² Whereas residential or industrial zones may be much more vulnerable to loss, government-owned or public infrastructure can be rebuilt more readily with civic funding. Food storage outside of a floodplain can abate consequences associated with food shortage, but requires either a strong exchange network or an agricultural economy capable of producing a surplus. Finally, a community's response may incorporate loss acceptance, which is a willingness and ability to rebuild following destruction in order to capitalize on the benefits of floodplain occupation. This choice to trade short-term losses for the

¹⁹¹ Dawdy (2002, 721-723) provides an illustrative example. After flooding in the wake of Hurricane Katrina in 2005, FEMA proposed a so-called "waste in place" strategy for New Orleans, in which damaged buildings would be demolished and buried with fill. Although eventually rejected for reasons related to the burial of household chemicals and appliances, this strategy was initially met with favor as it was seen to address clean up and raise the ground level for protection against future floods.

¹⁹² Sewell 1969, 436-438. See also Snowden (2006, 9, 32-51) for a discussion of modern Italy and its "national war on malaria," which included tremendous bureaucratic oversight aimed at eradicating malarial zones. The Italian government discussed numerous avenues of attack, including wide scale land reclamation, advice to their populace to flee the lowlands in favor of hilltops, and a housing revolution to transform rural housing of straw and stone to modern masonry with sealed windows.

long-term gains is especially effective for communities with limited technological capabilities and therefore little ability to prevent inundations.¹⁹³ In this scenario, the cost of loss may be offset by utilizing inexpensive and readily available construction materials, such as mudbrick, which can be used to rebuild cheaply and quickly.

In order to understand how such flood mitigation strategies may have been applied in Early Rome, it is possible draw analogies with a global history of riverine civilizations. Valuable comparanda comes from Egypt, a prime example of how environmental pressures can act as stimuli for cultural growth.¹⁹⁴ Utilizing irrigation farming and an intricate bureaucratic system, the ancient Egyptians were able to exploit the Nile's flood cycle and successfully endure numerous seasons of exceptionally high or low floods. Although Egyptian urbanism is generally considered as having been focused outside of the floodplain of the Nile, which was reserved for agricultural activity, there is significant evidence of habitation within the floodplain. Coring surveys around the Nile delta have provided extensive evidence of settlement on sand islands within the floodplain from at least the Old Kingdom.¹⁹⁵ Called *gezira* in Arabic, these natural sand levees permitted convenient habitation within a close proximity to the arable land.¹⁹⁶ Furthermore, at roughly 2 m above the surrounding floodplain, the settlements would have served as literal islands during periods of the inundation, protecting the mudbrick huts and the people living in them.¹⁹⁷ However, these settlements would not have been safe during periods of high flood, as the cores have identified. In the case of destruction during an extreme flood, the

¹⁹³ Torrence and Grattan 2002b, 12.

¹⁹⁴ Sewell 1969, 431; Butzer 1976, 106-112.

¹⁹⁵ Brink 1993, 282.

¹⁹⁶ Brink 1993, 282.

¹⁹⁷ Andres and Wunderlich 1992, 159; Dufton and Branton 2010. Scholars thought that the Temple at Karnak was constructed on one such island; however, recent archaeological research has suggested otherwise (cf. Bunbury et al. 2008, 355).

huts were subsequently rebuilt on top of the destroyed structures. In this process, the ground level was raised and subsequent hut structures were afforded even more protection from future high floodwaters.¹⁹⁸

Additionally, Medieval India has provided a valuable perspective on how a pre-modern society can cope with destruction from seasonal flooding. Mercantile centers in the Malay-Indonesian archipelago from the 13th through the 15th centuries were typically sited at river mouths.¹⁹⁹ These small, un-walled villages consisted of huts built of bamboo and dried mud, which were wiped out on a semi-regular basis, only to be rebuilt in a few days if necessary.²⁰⁰ These and other adaptive strategies have enabled river-focused societies throughout history to profit from direct access to natural resources and trade routes despite the risk of periodic destruction due to floodwaters.

Conclusions: some hypotheses for Early Rome

In the case of Rome, it is instructive to approach the role of the environment as a significant stimulus for early adaptive responses and civic growth.²⁰¹ With respect to their peer city-states in central Italy, which were typically centered on flat, steep-walled plateaus, the inhabitants of Rome chose to urbanize a disjointed and dynamic floodplain environment, a fact that led them to pursue landscape modification and maintenance from the city's inception. Civic investments in the Forum Boarium valley, in particular, seem specifically aimed at capitalizing on economic opportunities from the river harbor and interregional trade and communication networks. Landscape modification was a prerequisite for urban growth at Rome, as early

¹⁹⁸ Hassan 1997, 63.

¹⁹⁹ Wink 2002, 428.

²⁰⁰ Wink 2002, 429.

²⁰¹ Torrence and Grattan 2002b, 13.

adaptive responses enabled the inhabitants of Rome to combat the effects of nuisance flooding and develop a cohesive cityscape. Continued urbanization and resource exploitation in the Tiber River valley exacerbated floods and sedimentation at Rome, so that as the city's ground level rose, so did flood levels.²⁰²

The documentary and archaeological records provide much perspective on the types of adaptive strategies employed in Rome in the historical period, some of which were referenced in the previous chapter and are discussed in greater detail in subsequent chapters. Those that can be interpreted as flood prevention or mitigation measures include:

1. the use of boats to maneuver during periods of elevated river levels²⁰³
2. drainage of low-lying areas²⁰⁴
3. import and store food to prevent starvation following widespread agricultural land and cattle loss²⁰⁵
4. elevating constructions through the use of *podia*²⁰⁶
5. use of flood-resistant building materials (i.e., stone and hydraulic concrete)²⁰⁷
6. hydraulic engineering, such as embankment walls²⁰⁸
7. bureaucratic oversight, including political offices in charge of maintaining the Tiber²⁰⁹
8. dredging²¹⁰
9. creation of artificial harbor space (i.e., Testaccio and Ostia)²¹¹

²⁰² Aldrete 2007, 85-89; see detailed discussion in Chapter 5.

²⁰³ e.g., Dio 53.20.1; 53.33.5; 54.25.2; 57.14.7-8; 58.26.5; Zonaras 11.3; Claud. *De Bel. Gild.* 41-43; Am. Mar. 29.6.17-18 on the use of boats to supply food.

²⁰⁴ e.g., Livy 1.38.6, 1.56.2; Plin. *Nat. hist.* 36.24; Dion. Hal. *Ant. Rom.* 3.67.5, 4.44.1; Hopkins 2007; Aldrete 2007, 167-176.

²⁰⁵ For example, investments in *horrea* and importing enormous quantities of grain from Sicily and Egypt. For textual references to floods causing the destruction of farms and cattle, see Livy 4.49.2-3; 24.9.6; 35.21.5-6; Pliny, *Epist.* 8.17.

²⁰⁶ A standard feature of Italic temple architecture that may have been employed as a flood mitigation technique in the Forum Boarium (see discussion in Chapter 5).

²⁰⁷ e.g., Vitruvius 5.12.2-7

²⁰⁸ e.g., Pliny *Epist.* 8.17; Suet. *Caes.* 44; Plut. *Caes.* 58; Aldrete 2007, 167-177; 181-192.

²⁰⁹ e.g., Tac. *Ann.* 1.76; Dio 57.14.7-8; Suet. *Aug.* 37; *CIL* 6.31540 = *ILS* 5922; *CIL* 14.5320. See Aldrete (2007, 198-203) for further discussion.

²¹⁰ See discussion in Chapter 5.

²¹¹ See discussion in Chapter 5.

Despite the plethora of evidence from the second century BCE to the second century CE, when we have robust and contemporaneous historical sources, it is difficult to draw conclusions ecological processes during Rome's early history. Little is known about the origins and development of urban systems in Rome's floodplain, the Forum Boarium, in large part because stratigraphy associated with the pre-urban landscape is buried several meters beneath the modern city. Limited excavations at the Sant'Omobono Sanctuary have offered a tantalizing glimpse at early urban investments in the region, specifically a stone podium and altar that has been interpreted as a harbor shrine built adjacent to Rome's first river harbor. Based on this archaeological evidence, it is possible to conclude that the Romans sought to operate in this part of the landscape from the early sixth century BCE, if not earlier.²¹² Although details of the temple's immediate environs are obscured several meters beneath the modern surface,²¹³ it may be hypothesized that the river valley hosted an abundance of activities, whether commercial, pastoral, naval, agricultural, or otherwise. Adaptive strategies that may have been employed in the prehistoric era in order to prevent or mitigate the threat of recurrent floods of the Tiber include:

1. seasonal abandonment of flood-prone areas²¹⁴
2. loss acceptance
3. appeals to the gods for protection
4. reclamation of low-lying areas²¹⁵
5. siting building activity on natural terraces or levees²¹⁶
6. dredging of excess sediment
7. emergency response for clean-up and rebuilding

²¹² Diffendale et al. 2016; Brocato and Terrenato 2017. See further discussion in Chapter 4.

²¹³ Due to the inaccessibility of geological and archaeological levels (see Chapter 3) and limited documentary evidence from this period (see Chapter 1).

²¹⁴ cf. Ammerman 1998, 221.

²¹⁵ Intentional filling to raise the ground level, as occurred in the Forum Romanum (Ammerman 1990, 2013; Hopkins 2016, 27-34).

²¹⁶ In addition to the Sant'Omobono Sanctuary (see Chapter 5), the Regia, Comitium and Temple of Vesta in the Forum Romanum (Ammerman 1990, 634-635; 1996, 134-135).

8. limiting low-lying areas to public or elite building activity, while restricting private or domestic activity to the hills
9. use of inexpensive and readily available construction materials (i.e., mudbrick), which could be used to rebuild quickly and economically

The practicalities of Roman ritual practice, from the dedication of votive offerings to the veneration of a wooden cult statue housed within the temple, would suggest that a temple would not be erected in a position where it was vulnerable to flood waters. In analogy with incidents of buildings on *gezira* in ancient Egypt, I hypothesize a scenario where the Archaic temple in the Forum Boarium is protected at a higher elevation (due to natural geology and/or the use of a high stone podium), meanwhile the commercial activities would have taken place in simple mudbrick huts that could be predictably destroyed and efficiently rebuilt. Although certain adaptive strategies, such as loss acceptance, are impossible to discern in prehistoric contexts, a geoarchaeological investigations can test other theories by providing clues on the natural topography of the region and the scope of early human interventions. In order to explore the natural contours and the method of reclamation in the valley, I designed a coring survey of the Forum Boarium, which is the subject of the next chapter.

Chapter 3

Digging in the Valley: geoarchaeological methods and data

In the late 19th century, shortly after the unification of Italy, government officials and antiquarians commenced a massive program of urban reorganization and archaeological investigations in the new Italian capital at Rome. As venerated objects of nationalistic sentiment, large parts of Rome, including the entire Forum Romanum valley and the Palatine Hill, were stripped of their post-antique buildings and converted into archaeological parks that aggrandized the nation's ancient past by exhibiting monumental remains of the Republican and Imperial city. Rapid urban renewal in the Fascist Period continued to expose pockets of ancient architecture across the city, as was the case in 1937, when work in the Forum Boarium valley uncovered substantial remains of an ancient monument at the base of the 15th century church of Sant'Omobono. Seeing an opportunity to restore another ancient monument on Mussolini's grandiose Via del Mare, fascist officials granted the site protected archaeological status and modified plans for the construction of the city's administrative facilities, so that the building would partially enclose but not encroach upon the *Area Sacra di Sant'Omobono*.²¹⁷ Italian archaeologist Antonio Maria Colini was tasked to lead an initial, salvage excavation of the site, during which he identified the boundaries of a sanctuary consisting of two south-facing temples,

²¹⁷ The site of Sant'Omobono is bounded on the south and east by the brick-faced Uffici Tecnici of Ripartizione V of the Comune di Rome. For a detailed survey of the fascist era transformations in the Forum Boarium and the discovery of the Sant'Omobono Sanctuary, see Terrenato et al. 2012.

which he attributed to the goddesses Fortuna and Mater Matuta, with their associated altars positioned atop a large square platform measuring some 47m per side. In the process of reinforcing the foundation of the church of Sant'Omobono, some pits dug beneath the surface of the platform exposed layers of fill sediment that contained archaic materials, demonstrating the site's antiquity.²¹⁸

Spurred by propagandistic efforts to emphasize Italy's ancient glory, this surge of antiquarian interest and archaeological exploration in Rome during the late 20th and early 19th centuries heavily prioritized monumental architecture and fine sculptures that characterized the city in the Late Republican and Imperial Age, while the Archaic Period (580-480 BCE) represented a pivotal, but frustratingly obscure, era of socio-political and urban transformation. A history of this period is preserved in the text of Livy and others, who recount the story of Rome's kings and the beginnings of the Republic, this literary record was recorded several centuries after the era in question and is therefore hampered by biases and inaccuracies.²¹⁹ Archaeological explorations on the Palatine Hill and in the vicinity of the Temple of Jupiter Optimus Maximus on the Capitoline Hill uncovered material and architecture from the archaic city and exposed the internal geology of the hills themselves, but the original topography of Rome's lowlands remained obscured beneath several meters of urban stratigraphy accumulated over two and a half millennia of the city's existence (**fig. 14**). As a result of a progressive filling of the valleys, archaeological levels associated with the city's origins lie at a depth of more than 5m below the exposed Imperial surfaces in the Forum Romanum and Forum Boarium. At an elevation below the modern water table, wet conditions have created anaerobic conditions that

²¹⁸ Colini 1938, 1940.

²¹⁹ For discussion on the nature and the limitations of the historical record for early Rome: Cornell 1995, 1-26; Wiseman 2008, 1-23; Forsythe 2005, 59-77.

permit a high degree of organic preservation, a fact that makes early levels in Rome's valleys especially productive for archaeobotanical investigation. Despite the good preservation of material remains in Rome's valleys, issues related to the accessibility and visibility of these levels makes the archaeological record on Early Rome inherently fragmented. Moreover, conventional methodologies that utilized the historical record to formulate chronologies and interpretations of Imperial and Republican Rome, found limited applicability in pre-Republican contexts.²²⁰

Faced with considerable obstacles that restricted investigation of Rome's origins, generations of archaeologists have developed and adapted methodologies specifically for the purpose of accessing and studying deeply buried archaeological levels in Rome's valleys. Working at the turn of the 20th century, Italian archaeologist Giacomo Boni, heralded as the father of Italian field archaeology, was the first to introduce science-based principles of stratigraphic excavation in Rome. Seeking to identify the base of the archaeological sequence in the Forum Romanum, Boni produced a series of narrow soundings, successfully exposing abundant charred plant remains and the transition to natural soil at a depth of 6m.²²¹ His discoveries of *in situ* archaic material, including the *Lapis Niger*, fueled new discussions on the origins of the Forum Romanum and the evolution of the Roman state. In the post-war period, Boni's pioneering, but largely unpublished work was picked up by Swedish archaeologist Einar Gjerstad, who conducted a series of new deep soundings in the Forum Romanum as well as in the Forum Boarium during research for his seminal, multi-volume work, *Early Rome*. Having already excavated a nearly 6m deep trench at the so-called *Equus Domitiani*,²²² in 1959 Gjerstad

²²⁰ See discussion in Chapter 1.

²²¹ Kampen et al. 2005.

²²² Gjerstad 1952.

conducted a similar sounding near the apse of the Sant'Omobono church, successfully exposing a small section of a stone podium buried 5m beneath the surface of the Republican platform along with an assortment of archaic ceramics and architectural terracotta presumed to be associated with at least two phases of a temple building oriented towards the southwest (**figg. 15, 16**).²²³ The preservation of organic remains at Sant'Omobono fueled pioneering analyses of vegetal and faunal remains,²²⁴ contributing valuable data and methodological contributions to the emergent field of environmental archaeology.

In the 1980s, with several archaeological endeavors underway in the center of Rome, American archaeologist Albert Ammerman introduced the novel method of coring survey in an effort to sample a wider area than that permitted by individual deep soundings. Derived from modern geological techniques, coring survey involves the use of manual or mechanical cores that are drilled several meters below the surface to produce a borehole profile of the underlying archaeological and geological stratigraphy. Using coring survey and sedimentological analysis, Ammerman offered a reassessment of Boni and Gjerstad's excavations in the Forum Romanum, by documenting the natural relief of the valley and offering a new interpretation of the complex sequence of stratigraphic layers.²²⁵ His work demonstrated that the pre-urban land surface in the valley was low and subject to seasonal flooding of the Tiber, so that early mudbrick structures in the valley would have been jeopardized on a periodic basis. Ammerman furthermore interpreted the lowest archaeological levels in the valley as belonging to a massive reclamation project that involved dumping large volumes of earth and raising the surface of the valley to an elevation that was protected from seasonal floods. In an effort to extend his survey across the entire Velabrum,

²²³ Gjerstad 1960, 1962.

²²⁴ Ioppolo 1972; Costantini and Costantini Biasini 1989; Tagliacozzo 1989.

²²⁵ Ammerman 1990, 1996.

the valley that separates the Capitoline and Palatine Hills, Ammerman oversaw the production of a preliminary set of cores in the Forum Boarium, from the modern street level west of the Forum Romanum and from the exposed ancient surface at the Sant'Omobono Sanctuary (**fig. 16**).²²⁶ While working near the River, however, his team encountered difficulties when drilling below the modern water table, as very often the loose, waterlogged sediment would either be compressed or simply fall out of the drill bit during the extraction process.²²⁷ This complication largely precluded the recovery of samples associated with archaic levels in the Forum Boarium, but still produced valuable new perspective on the natural relief and subsurface geology of the Velabrum basin. Among other things, he determined that the original position of the Tiber River was approximately 100m east of its modern course.²²⁸ Ammerman also rejected the established notion, derived from the historical record,²²⁹ that the Velabrum valley was once occupied by a standing body of water and instead argued that the region was seasonally wet and dry during the first millennium BCE.²³⁰

Decades of research carried out in and around the Sant'Omobono Sanctuary provided limited, but tantalizing access to levels associated with Rome's original river harbor. With numerous interpretive questions still unanswered, a new project, jointly sponsored by the University of Michigan and Università della Calabria, reopened investigations at Sant'Omobono in 2009 with the goal of reevaluating earlier explorations and bringing modern methodologies

²²⁶ Ammerman 1998.

²²⁷ For discussion of recovery problems related to coring at great depth and below the water table, see Ammerman 1998, 217, n. 8, 13; 2006, 300.

²²⁸ Ammerman et al. 2000; Ammerman and Filippi 2004; Ammerman et al. 2008.

²²⁹ Multiple references in the historical record (Varro *Ling* 5.43-44; Plut. *Rom.* 5.5; Ovid *Fasti* 6.395-417; Prop. 4.9.5) suggest that the Velabrum valley was regularly or even permanently flooded during Rome's early history, a circumstance that supposedly required the use of a ferry to permit travel from the Aventine Hill to the center of the city.

²³⁰ Ammerman 1998, 291; Ammerman et al. 2008, 26.

and scientific analyses to bare on the complex site (**fig. 18**). Following years of archival research and the reexamination of old trenches,²³¹ in 2013 the Sant’Omobono Project commenced an ambitious program of geoarchaeological investigation aimed at exposing the full depth of the archaeological sequence at the Sanctuary and sampling levels associated with the pre-urban landscape. Two trenches, including one positioned to expose the western side of the Archaic temple podium, were excavated to a depth of 5m and, running concurrently, I conducted a coring survey across the site of Sant’Omobono (**fig. 19**) and later from the street level around the Forum Boarium (**fig. 20**). These combined, interdisciplinary endeavors have helped to expose the pre-urban landscape and early urban activity in this key region along the Tiber River where Rome’s original river harbor was located. In addition to describing the geoarchaeological methodologies and sampling program employed by this project, this chapter presents a general introduction to the types of archaeological and geological stratigraphy exposed in this coring survey. Ultimately, I argue that the growing integration of coring survey and earth science approaches into archaeological research can reveal new details on early Rome by exposing previously concealed stratigraphy associated with the city’s origins. Ongoing and future geoarchaeological investigations of Rome’s valleys stand to unlock a new trove of physical information on the ancient city; these methodologies, to some extent pioneered in Rome and specifically at the Sant’Omobono Sanctuary, can find wider applicability in other urban areas where a city’s origins are deep and obscure.

²³¹ For further background on early excavations at Sant’Omobono and the reassessment of materials produced during these campaigns, see Brocato et al. 2012, 2016; Terrenato et al. 2012; Brocato and Terrenato 2012, 2017; Diffendale et al. 2016.

Deep trench excavation at Sant’Omobono

With substantial support from the National Science Foundation in 2013,²³² the Sant’Omobono Project conducted excavation of two new trenches, which were intended to access the earliest habitation levels of the site. Attempts to reach archaic levels at Sant’Omobono pose formidable challenges, the foremost of which is sheer depth. The currently exposed surface of the site, a composite of Republican and Imperial pavements of the sanctuary platform, stands around 13m above sea level (hereafter masl). The interior of this platform, originally constructed in the early 5th century BCE,²³³ consists of large fill deposits that extend a full 5m above levels associated with the Archaic temple, which are around 7masl. Even with the aid of modern safety equipment and archaeological techniques, the task of excavating a 5m deep trench remains daunting and potentially dangerous, a factor that has long obstructed archaeological investigations of early levels in Rome’s valleys.

Compounding the difficulties associated with depth, groundwater significantly impedes archaeological investigations in the Forum Boarium. Located on the east bank of the Tiber River, the modern water table at Sant’Omobono is consistently high, around 10masl depending on the amount of seasonal rainfall. Thus, water begins to seep into any trench that approaches archaic levels. Flowing at a slow but constant rate, water quickly accumulates in the trench and obscures any stratigraphic excavation. Ironically, while the high water table is problematic, it is also tremendously advantageous: anaerobic conditions have prevented microbial decomposition of organic remains. Thus, despite the challenges associated with visibility and access, the waterlogged levels at Sant’Omobono have made possible the conditions for organic preservation.

²³² Grant number 1259122, Principal Investigator: N. Terrenato.

²³³ Diffendale et al. 2016.

The location of these two deep trenches was determined primarily by gaps in the Republican and Imperial paving stones that serve as windows to the Archaic Period; of these fortuitous windows, two areas were deemed to be both sizable and safe enough to excavate a 5m deep trench. In the summer of 2013, we began work on trench D10, which was located immediately south of the modern church (see **fig. 19**). Our goal was to expose the western side of the Archaic temple podium. Although portions of this podium had been revealed during early excavations at Sant’Omobono, this new exploration was intended to reassess and properly document the problematic stratigraphic sequence as well as to acquire a variety of environmental samples. In the summer of 2014, a second trench (A7) was positioned inside the other accessible part of the site, the cella of the western temple. Before work commenced, each trench was outfitted with extensive safety equipment, as directed by engineering consultants. To prevent collapse of the trench walls, cranes maneuvered massive metal support structures, typically employed in construction and engineering projects (**fig. 21**). During the digging process, the metal slats were periodically lowered to match the excavation level, so that we were protected from collapse from above. With dimensions of 2.1 x 4.3m, only two people could reasonably excavate inside trench D10 at any given time. Slightly larger at 3.1 x 4.8m, A7 could comfortably fit three excavators. In short, conditions were cramped, making work in both trenches tedious and slow.

In addition to the protective shoring, electrical pumps were employed to extract the water as the excavators worked well below the water table. A consultant from the Museum of London Archaeology with experience in waterlogged excavation, Alison Telfer, consulted on our strategy as we proceeded to the lower, waterlogged levels. Upon encountering water, roughly 2m into each sounding, we were confronted with constant streams of water from countless small

springs, which caused numerous delays to our work and necessitated the use of electrical immersion pumps. In order to collect the water as it seeped into the trench, we dug a deep hole, or sump, into which we placed a pump that extracted the water and channeled it through a series of long tubes before being dumped in a drain at the edge of site. Although the sump hole destroyed stratigraphy and subtracted from viable excavation space, it was the only viable option in these waterlogged conditions. When effective, the stratigraphy in the remainder of the trench was muddy, but remarkably clear. Generally speaking, while excavating waterlogged levels, at least a quarter of the excavators' time was spent focused entirely on extracting water, while approximately 10% of the excavation area was lost for water-collection purposes directed at the same objective. The relentless infiltration of water complicated operations further by persistently dropping sediment on the excavation surface. This introduction of new sediment (and potentially other materials) onto the excavation surface risked contaminating contexts and samples, which prompted us to take extra precautions with environmental sampling, such as collecting sediment and pollen samples only from freshly exposed areas. Given the potentially long-term hazards of maintaining open trenches and the sizable expense of the shoring equipment, which were leased from a local engineering company, both soundings had to be started and completed in two months. At the conclusion of each of the two field seasons, the shoring equipment was to be removed notwithstanding the status of the excavation. There was little room for flexibility, as the trenches were to be backfilled regardless of whether our work was complete.

Having overcome complications with the water table and a tight schedule, our team's work in both trenches proved successful. Buried beneath 5m of anthropic fill within the interior of the Sant'Omobono platform, the western side of the Archaic temple podium was exposed (**fig. 22**), along with sizable quantities of fine pottery and terracotta sculptures, which together

indicate that the construction should be assigned to the early 6th century.²³⁴ At an elevation of 6.5masl, the podium was built on top of alluvial, floodplain sediment, which represents the boundary between natural sediment and archaic habitation levels. In trench A7, we revealed the full height of the platform down to the natural surface at 7.5masl (**fig. 23**). These deep trenches not only provided ample new data on the Archaic harbor temple building, but also unprecedented access to layers associated with the natural landscape of the floodplain.

Coring survey at Sant’Omobono and in the Forum Boarium

As a member of the Sant’Omobono Project, I had the opportunity to direct an extensive coring campaign in conjunction with the deep trench excavation, during which I conducted a survey of the entire site of Sant’Omobono and, subsequently, the surrounding region of the Forum Boarium.²³⁵ In order to make this project successful, more than 20 individuals who offered requisite expertise were recruited to consult or participate in various aspects of the survey. In addition to the field crew, a group of American and European scientists with diverse areas of expertise (paleoethnobotany, geology, micromorphology, physical geography, pollen, among others) were invited to participate in the analytical phase of the project and to employ a large set of modern techniques in geoarchaeology and paleoenvironmental studies. These collaborative relationships proved invaluable and mutually beneficial. For example, through a collaboration with the Istituto Nazionale di Geofisica e Vulcanologia (INGV) in Rome, we were able to draw upon the expertise of local geologists, who offered to pay to deepen some of our

²³⁴ Diffendale et al. 2016, 10-14; Brocato and Terrenato 2017.

²³⁵ The percussion coring survey was conducted as part of a larger NSF-funded research campaign at the site (supra n. 232). I carried out the mechanized coring survey of the Forum Boarium with the support of the Etruscan Foundation, the Lemmermann Foundation, and the Rackham Graduate School. Additional funds provided by the Istituto Nazionale di Geofisica e Vulcanologia in Rome.

boreholes (the deepest reaching 56m below the modern street) for their own ancillary research objectives. In this way, I have sought to maximize the productivity of this coring survey beyond the confines of archaeological or historical research.

At Sant’Omobono, gasoline-powered Cobra TT drilling equipment (**fig. 24**), allowed us to core in open trenches and occasional gaps in the Republican and Imperial pavement stones, accessing stratigraphy up to 8m in depth from the exposed surface. Unlike excavation, coring provides a relatively cost-effective and non-invasive way to study deep stratigraphy over a wide area. The resultant sediment boreholes have a diameter of 5cm (**fig. 25**) and contain a trove of environmental data (e.g. soil horizons and stratigraphic profiles) as well as anthropic material (e.g. fragmentary artifacts and habitation surfaces). Although Albert Ammerman, who consulted on the coring strategy at Sant’Omobono in 2013-2014, produced a few similar percussion boreholes along the extreme western edge of the site in 1998,²³⁶ his analysis was largely inconclusive; this new survey was designed to produce more data on Archaic occupation at the site as well as on the natural topography of the pre-urban landscape.

We focused our drilling efforts in locations that would maximize topographic inferences by producing transects of data points across the site. Of course, access to deeply buried stratigraphy was hampered by the limited availability of unobstructed ground surface; there are only so many potential areas on site, free of stone architecture, where it is possible to core with percussion equipment.²³⁷ Numerous boreholes, for that matter, were blocked by stone at shallow depths. When unencumbered, each borehole was drilled and extracted in 1m stages. We used a combination of open metal sampling bits, which could be immediately analyzed on site, and

²³⁶ Ammerman et al. 2000, 13, fig. 1.

²³⁷ The more powerful, mechanized drilling equipment used from the street level in the Forum Boarium was too large to bring onto the archaeological site of Sant’Omobono.

samplers with plastic PVC tubing, which could preserve the borehole for years if necessary. Despite challenges with accessibility, our team achieved 18 separate entries across the excavation area, producing 76 linear meters of stratigraphic record. Several cores were placed inside open trenches, including D10 and A7, as well as other areas that were impossible or unlikely to be excavated. By seeking out the lowest exposed surfaces on site, we bypassed the most-recent and best-documented layers and increased our chances of an unobstructed borehole. This strategy proved fruitful, as it resulted in repeated samples at and below Archaic levels from across the excavation area.

Following this two-year program of deep explorations at the Sant’Omobono Sanctuary, which provided substantial perspective on the Archaic temple and its immediate environs, I directed a second coring survey intended to widen the area of study by sampling early stratigraphic levels across the Forum Boarium (see **fig. 20**). I designed this study in order to collect additional topographic and environmental details on the position and context of the Archaic temple in relation to Rome’s original river harbor, presumed to exist beneath the modern Palazzo dell’Anagrafe.²³⁸ Operating outside of the archaeological zone of Sant’Omobono was a fresh challenge. Specialized equipment was required in order to drill from the modern street level around the Forum Boarium, a bustling region of modern Rome packed with tourists and governmental agencies. We enlisted experienced geological contractors, CNG S.r.l, a company based in Rome and led by Dott. Geol. Marcello Martinelli, with whom we discussed a coring

²³⁸ Coarelli 1988; 1992, 23-25, 215-221. In addition to the southwest facing of the Archaic temple at Sant’Omobono, the location of the river harbor has been inferred from a combination of literary and topographic references from the historical period. Dionysius of Halicarnassus (*Ant. Rom.* 9.68.2) describes a harbor capable of supporting large ships at a wide part of the Tiber in the vicinity of the Pons Sublicius. Varro (*Ling.* 6.19) mentions the existence of a portus in the vicinity of the Temple of Portunus, which is conventionally believed to be the ionic temple on the north side of the Piazza della Bocca della Verità. See further discussion below.

strategy for preserving archaeological materials and soft, alluvial sediments that were often not retained during conventional geotechnical surveys. Partially restricted by the modern buildings and streets in the Forum Boarium, we could only core on the sidewalk and in areas of exposed ground around other ancient architectural remains in the region. I identified 12 coring locations that would help create transects of data points with known levels at the Sant'Omobono Sanctuary, and coordination with CNG, the INGV, and the Comune di Roma ensured that the selected coring locations did not align with known underground utilities and could be cordoned off during the coring work.²³⁹

Using a Beretta drilling rig capable of passing through concrete and hard stones (**fig. 26**), the CNG technicians could produce sediment boreholes with a diameter of 8cm to a depth of more than 50m (**fig. 27**). In an effort to expose the lowest levels of anthropic activity and sample the pre-urban geology of the valley, each of the 12 cores in the Forum Boarium was drilled to a minimum depth of 15m. A single core on the western edge of the valley was drilled to a depth of 56m below the modern surface, as part of an ancillary investigation of the Tiber River's aggradation history led by members of the INGV, discussed below. Given the challenges encountered during Ammerman's attempt to survey the region, namely problems associated with the recovery of soft sediments at the boundary with the modern water table,²⁴⁰ we expected the extraction of the drilling bit from the hole to be an especially precarious process. In order to achieve full recovery of each borehole, our geological contractors devised an effective strategy to plug the open end of the drill bit. The operator would drill through loose,

²³⁹ Despite the involvement of city officials and having utility maps on hand, we still excavated the top 1.5m of each borehole by hand and shovel, so that we would not drill through any modern infrastructure. Indeed, one of the cores had to be shifted by several meters after we encountered an unexpected pipe just beneath the modern surface.

²⁴⁰ *supra* n. 227.

soft sediment until he reached a level of stone or compact sediment, which would serve to plug the open end of the drill bit. When no stone or compact sediment was encountered, the operator could rapidly spin the drill bit to heat and harden the soft sediment into a makeshift plug. The machine operator needed to sense the composition of the sediment through which he was drilling and react accordingly, so that he did not lift the drill bit until the sediment was secured, a technique that permitted us to achieve nearly 100% recovery in every borehole, resulting in another 244 linear meters of stratigraphic record.

Coring survey: stratigraphy, sampling, and chronology

Following the fieldwork phase, the boreholes, divided into 1m sections and brought to laboratory space at the Sant’Omobono church (**fig. 28**), were analyzed and sampled in turn and recurrently.²⁴¹ First, I performed a systematic examination of the stratigraphy in each borehole, which included cleaning, photographing, drawing, and writing detailed descriptions of sediment (color, texture, granulometry, mineralization) and noting the presence of macro-remains (vegetal, faunal, ceramic, and stone inclusions). Drawing on sedimentary characteristics and composition, I sought to identify and distinguish between natural and anthropic levels (**figg. 29-31**). The products of natural forces, geological levels exposed in the coring survey of the Forum Boarium include fluvial (sediments deposited by water), colluvial (sediments washed downslope from the nearby hills), and lacustrine (sediments deposited in standing water) deposits. A result of human activity, archaeological layers from this study include fills (sediments deposited in secondary context), building materials (stone or mortar features), and general anthropic deposits of

²⁴¹ Analysis occurred at the site of Sant’Omobono in the summers of 2014-2016. In order to preserve their longevity, the boreholes were kept moist and out of direct sunlight. Between field campaigns, the boreholes were wrapped in plastic and stored beneath the church of Sant’Omobono, where they remain today.

undetermined purpose. As geological levels can have anthropogenic inclusions, and archaeological levels may not have straightforward indications of anthropic materials or visible signs of disturbance, such inferences are not always readily apparent. Thus, a sampling program was designed with two broad goals: better elucidate the depositional environment of the stratigraphy preserved in the boreholes and establish a chronological framework that would permit stratigraphic correlations between the boreholes.

After my initial examination, the boreholes were scrutinized under the guidance of the scientific collaborators on the project,²⁴² at which point we chose samples for a variety of laboratory analyses, including pollen residue, micromorphology, granulometry, and paleomagnetism. Additionally, sediment samples were selected for wet sieving, which yielded additional macrobotanical and faunal remains, further expanding our collection of candidates for radiocarbon testing. During examination over a three-year period, a combination of archaeological and scientific age markers identified from this coring survey have created a robust absolute chronology for the 18 percussion boreholes from Sant’Omobono and 12 mechanized boreholes from the Forum Boarium. **Table 1** enumerates the chronological markers employed by this project, an amalgamation of diagnostic ceramics, building materials, radiocarbon dates. In addition to this list, scientific collaborators from the INGV have conducted an experimental study of the paleomagnetic signals from four sections of boreholes FB 38, 40, 43, and 47.²⁴³ Although this method and results will be detailed in other publications, preliminary analysis corroborates the chronology already established by ceramic and radiocarbon dates; respective

²⁴² L. Motta (paleoethnobotanist), F. Marra (geologist), C. Nicosia (micromorphologist), J. Sevink (physical geographer), L. Sadori (pollen)

²⁴³ F. Marra, F. Florindo, and P. Macrì.

sections in FB 43 and 47 display a similar paleomagnetic signal, suggesting that the sediment in these two sections was deposited contemporaneously.

It is worth emphasizing that not every chronological marker is equally reliable, and each date should be judged based on its stratigraphic context and relative agreement with other chronological markers. Given the hydrology of an active river valley, it is not uncommon to find chronological markers, whether ceramic or organic used for radiocarbon dating, that yield ages that are clearly out of sequence with regard to their stratigraphic position covering younger contexts.²⁴⁴ These inconsistent dates are reflective of reworked, older material being incorporated and redeposited within younger, alluvial contexts. It is critical, therefore, to have an abundance of dates and assess the reliability of each one within the broader context of an entire borehole and the picture provided by the whole survey.

For the remainder of the discussion, I refer to some key stratigraphic levels and broad chronological phases, which are summarized by elevation and core in **Table 2**.²⁴⁵ Late Republican levels are identified by the presence of mortar and, therefore, date no earlier than the mid-second century BCE.²⁴⁶ In the case of the Forum Boarium boreholes,²⁴⁷ inclusions of mortar and pozzolanic ash, found in abundance in the Bay of Naples and one of the primary components of mortar, provide a clear horizon with a *terminus post quem* in the mid-second century BCE.²⁴⁸

²⁴⁴ e.g., ¹⁴C samples 22, 23.

²⁴⁵ All elevations for this project are based on the datum used by the Sant'Omobono Project, the metal benchmark on the walkway outside the apse of the church, which has recently been measured with a professional GPS system at 14.069masl. This value is slightly different (0.182m lower) than the datum used prior to 2017, including elevations cited in Brock and Terrenato 2016.

²⁴⁶ Mogetta (2015) has recently re-evaluated the evidence for the invention of hydraulic concrete and down-dated this technological innovation to the mid-second century BCE.

²⁴⁷ As the Sant'Omobono cores were drilled through and below levels associated with the Late Archaic platform, the material from these boreholes contain no mortar inclusions.

²⁴⁸ Hydraulic concrete is composed of mortar made with lime and pozzolanic ash, which is a naturally occurring volcanic sand found in abundance in the region of Mount Vesuvius (see Mogetta 2016, especially n. 10). The presence of *pozzolana* in the Forum Boarium boreholes is generally interpreted not

In contrast, mid-Republican levels are associated with anthropic deposits lacking mortar and with ceramic or radiocarbon dates between the fourth and second centuries BCE.

Pre-Republican levels at Sant’Omobono and in the Forum Boarium are dated largely on the basis of identifiable Etruscan bucchero, as well as Attic and Corinthian pottery, which provide greater precision than radiocarbon testing. Given the coincidence of the Hallstatt Plateau—a plane on the calibration curve that causes radiocarbon dates to convert to a less helpful calendar age range of several hundred years—stratigraphy from the period between 800-400 BCE is best identified with datable ceramics.²⁴⁹ The early fifth century monumental platform, which supports the twin temples of Fortuna and Mater Matuta, is a major building phase at the site.²⁵⁰ As is apparent in my profile drawings of boreholes from the Sant’Omobono Sanctuary, much of the stratigraphy exposed during the percussion coring survey is associated with the construction of this Late Archaic platform (see **fig. 29**). By coring through the sediment fill within this structure, several boreholes exposed the boundary with the natural land surface beneath Archaic levels, around 7masl; this surface, upon which the Early Archaic temple was erected in the early decades of the sixth century,²⁵¹ is interpreted as alluvial sediment deposited in the floodplain of the Tiber.²⁵²

When possible, I tried to core around the edges of the platform at Sant’Omobono, in order to sample the geological sediments in the immediate vicinity of the Late Archaic platform and attempt to identify the boundaries of the floodplain. Borehole SO 30, positioned over the western edge of the platform, exposed fluvial sands typical of active river channels; these levels

as a natural deposit, but as secondary material introduced from elsewhere, presumably for the purposes of concrete construction in Rome.

²⁴⁹ cf. ¹⁴C samples 6, 12, 15.

²⁵⁰ Diffendale et al. 2016, 22-25. See also chapter 5.

²⁵¹ Brocato and Terrenato 2017; Diffendale et al. 2016, 10-14; see also Chapter 5.

²⁵² cf. Ammerman and Filippi 2004, 17-18.

were surveyed more thoroughly during the coring survey of the Forum Boarium in 2015 (see **fig. 30**). Cores drilled along the northern edge of Sant’Omobono revealed stratigraphy related to Pleistocene deposits within and beneath the Capitoline Hill. Boreholes SO 36 and 32 exposed the gravel shoulder of the Capitoline Hill at 7.5masl along the northern boundary of the Sant’Omobono Sanctuary; this natural feature could very well have served as a convenient surface for the original Vicus Iugarius, the road that leads from the Forum Boarium along the shoulder of the Capitoline Hill to the Forum Romanum.²⁵³ An especially deep cluster of cores drilled at the bottom of trench A7 (boreholes SO 22-26) exposed anthropogenic deposits immediately above a pre-existing alluvial terracing dating from the Pleistocene epoch. Radiocarbon analysis on four seeds from these anthropic contexts have provided dates in the late second millennium BCE and are discussed in the next chapter. Borehole SO 47, drilled beyond the eastern edge of the early fifth century platform, exposed a 41cm thick deposit of animal dung around 8masl. Samples from this extremely rare discovery—only possible due to the anaerobic conditions of the waterlogged contexts in the valley—have been disseminated to labs in Europe to undergo a variety of analyses, including DNA identification. Dating broadly to 754-411 cal BCE,²⁵⁴ this dung deposit falls within in the Hallstatt Plateau and did not contain any diagnostic ceramics, so it could be contemporaneous with several known building phases at the Sant’Omobono Sanctuary. It is possible, though, that the ground level on the eastern edge of the early fifth century platform at Sant’Omobono remained open and as low as 8masl. It may even be hypothesized that the northeastern corner of the early sixth century temple remained visible even after the temple’s abandonment in the late sixth century and the subsequent construction of

²⁵³ cf. Ammerman 2000. Borehole FB 41 exposed a basalt surface with mortar at an elevation of 15masl, which is interpreted as the imperial version of the same street.

²⁵⁴ ¹⁴C sample 6.

the massive platform and temples to Fortuna and Mater Matuta.²⁵⁵ If the ground level in the vicinity of borehole SO 37 was as low as 8masl until the fifth century, this suggests that the Early Archaic podium could have been exposed at the base of the eastern wall of the Late Archaic platform (see **fig. 16**). Further results remain pending and this hypothesis will be tested with future coring survey. The southern portion of the Sant’Omobono site was less accessible for coring and the presence of modern buildings obstructed us further, so we were unable to identify the southern limit of the floodplain beneath Sant’Omobono. Coring in the southern portion of the Forum Boarium, however, exposed lacustrine deposits associated with a swampy feature called an alder carr (see **fig. 31**), which existed in Velabrum valley in the Neolithic period, millennia before the beginnings of human settlement at Rome.²⁵⁶

Once we succeeded in accessing pre-Archaic levels in the Forum Boarium, radiocarbon dating of organic material became crucial, as the nondescript sherds of impasto from these layers are generally only diagnostic for the Late Bronze Age-Early Iron Age transition. Visual inspection of the boreholes and wet sieving of sediment samples produced a collection of organic remains, of which only certain materials were selected for AMS radiocarbon dating, while the majority of the organic material from the boreholes is still undergoing study and will be presented in future publications. Radiocarbon samples were distributed to one of three labs for analysis: Beta Analytic (Miami, Florida), the Centre for Isotope Research at the University of Groningen (Groningen, the Netherlands), and the Center for Isotopic Research on Cultural and Environmental Heritage at the Seconda Università di Napoli (Caserta, Italy), where pre-treatment of the sample materials was performed by laboratory technicians with routine acid/alkali/acid

²⁵⁵ cf. Diffendale et al. 2016; Brocato and Terrenato 2017.

²⁵⁶ This feature was exposed during a previous coring survey of the valley (Ammerman et al. 2000; 2008; cf. Di Rita et al. 2010, 61-62). See further discussion in Chapter 4.

washes. **Table 3** lists dates as a conventional radiocarbon age (BP) with a conservative range of 30 years. The calendrical calibrated ranges were plotted on the IntCal13 calibration curve²⁵⁷ and are shown in the same table at the 68% (1 σ) and 95% (2 σ) confidence levels. Devised in consultation with key scientific collaborators, our selection criteria for radiocarbon samples is outlined in the following table, beginning with materials considered to be the most preferred and reliable:

1. A single seed (or pollen grains, when available)
2. Animal products (bone, teeth, dung)
3. Wood (identified not as a piece of root tissue)
4. Charcoal
5. Multiple seeds from the same stratigraphic context
6. Generic plant remains extracted from a sample of organic sediment

In general, seeds are the preferred material for radiocarbon dating samples from sediment boreholes. Unlike charcoal and charred wood, which can survive in abundance and contaminate later contexts with earlier dates, the delicate material of most seeds would indicate that the context was not heavily disturbed by post-depositional processes, thus minimizing the risk of contamination. When seeds were unavailable, bone or wood were the second-best option for radiocarbon dating. In the case of wood fragments, the sample was identified by species (when possible) and confirmed to be an above-ground piece of plant tissue,²⁵⁸ as roots can contaminate older contexts with younger dates. If a single seed was too small, multiple seeds from the same stratigraphic context, if available, were combined in order to provide sufficient carbon for AMS radiocarbon analysis.²⁵⁹ Although viable, these amalgamated samples are less ideal than testing a

²⁵⁷ Talma and Vogel 1993; Reimer et al. 2013.

²⁵⁸ Additional details on this project's paleoethnobotanical analysis and data will be presented by L. Motta in a future publication.

²⁵⁹ Seeds as small as 4mg are sufficient for modern AMS dating techniques.

single piece of organic material as the result is an average radiocarbon age based on all of the carbon in the sample.

Contexts that lacked both diagnostic ceramics and macro-botanical remains were dated through other means, including radiocarbon analysis on sediment samples or (when available) pollen residue. Pollen grains collected from lacustrine deposits in boreholes FB 38 and 40 were submitted for radiocarbon analysis and returned dates in the sixth-fifth millennium BCE (see **fig. 31**).²⁶⁰ Radiocarbon analysis was also performed on carbon or generic plant material extracted from a small sample of organic sediment. Like dates on multiple seeds, sediment samples proved to be the least reliable for radiocarbon dating. We found, not unexpectedly, that when coring in the Tiber's alluvial plain, dates were sometimes clearly out of sequence, interpreted as reworked material deposited by the river.

Conclusions: implementation in other urban contexts

The combination of excavation with subsurface survey, in particular, permits new opportunities to produce substantive results and shed light on Rome's urbanization process in the prehistoric era. Coring survey permits unprecedented access to early levels, still preserved and buried deep beneath the busy streets of Rome. As demonstrated in the Forum Boarium, environmental archaeology has the capability of producing new, robust data on the city's origins. In this way, the setting of Early Rome is illuminated and removed from the realm of speculation by being at least partially grounded in empirical evidence. By eliminating this once unknown variable, it becomes possible to discuss the evolution of Rome in concrete terms, drawing on firm evidence. The success of this ecological approach rests in the cross-disciplinary

²⁶⁰ Additional details on this project's pollen analysis and data will be presented by L. Sadori in a future publication.

methodologies and diversity of evidence, as it transcends traditional scholarly boundaries by incorporating archaeological, geological, literary, and comparative material.

If applied in other cities, these techniques can facilitate much needed collaborative research on the environmental history and impact of urban centers on their landscape. The large degree of land inflation and urban overburden at Rome is far from unique, and these methodologies are proven to be effective even when a city's origins are deep and obscure. Extensive or open-area excavation, while preferable, is often impossible in the middle of a modern city. Deep trench excavation, albeit a more thorough methodology, is costly and dangerous. As demonstrated by this project, there remain practical and productive methods of investigation, which allow the archaeologist to access deeply buried deposits. Subsurface survey is a relatively cost-effective and non-destructive method of obtaining topographic and geological data points across a wide surface area, providing the possibility for site-wide or regional reconstructions. Deep trench excavation is expensive and logistically challenging, but provides the unmatched opportunity to collect artifacts and recognize small features (post holes, hearths, burials, etc.) that are often missed or difficult to identify in cores.

Although each method has merits in its own right, the most compelling results emerges with the analytical synergy of the two. This multi-scale approach provides complementary macro- and micro-perspectives on deep sites. Excavation can expose structures or features in their entirety, providing the necessary detail to formulate higher-level conclusions about the form and function of human occupation. Although less helpful for identifying particular buildings or thoroughly studying specific contexts, as there are limits to inferences drawn from a single borehole, subsurface survey creates an opportunity to test broad topographic hypotheses by expanding the area of investigation and corroborating excavation data with a multitude of

environmental samples from across a larger landscape. When applied to a diverse set of scientific and historical research questions, such evidence can prove invaluable for paleoenvironmental reconstructions and investigations of stratigraphic levels associated with a city's early development. In the case of Rome, this cross-disciplinary research is shedding new light on the pre-urban environment and the crucial role of ecological stress and human adaptation during the early stages of urbanization.

Chapter 4

Reconstructing the Pre-Urban Landscape of the Forum Boarium Valley

In contrast to other prehistoric settlements in northern and central Italy, which were often centered on high, flat volcanic plateaus,²⁶¹ the early inhabitants of Rome chose to settle a unique landscape forged by Pleistocene volcanism and subsequent sea level changes. Between 600,000 and 300,000 years ago, a series of eruptions of the Sabatini and the Alban Hills volcanoes produced huge pyroclastic deposits that created a plateau in the area of Rome and modified the course of the Tiber.²⁶² The heterogeneous sequence of volcanic deposits, which make up the internal structure of Rome's hills, generally consist of soft stone, or tuff, which is easily eroded.²⁶³ As a result of a low sea level during the last glacial maximum, this volcanic plateau at the site of Rome was deeply incised by the Tiber River and its tributaries, before sea level rise in the Holocene prompted alluviation and a gradual infilling of the river valleys.²⁶⁴ The result of these geological processes is the distinctive topography that would characterize and demarcate the later city: a collection of high hills with steep cliffs and low, flood-prone valleys (**fig. 32**). By

²⁶¹ The position of these hilltop settlements is often interpreted as reflecting a need for defense in an era when raiding and looting were common (cf. Smith 1996, 34-7; 2007, 162-164; Barker and Rasmussen 1998, 16-25).

²⁶² Key references on the geology and environment of Rome: Ventriglia 1971; Blasi 1994; Funicello 1995; Blasi et al. 1995; Cignini et al. 1995; Karner et al. 2001; Parotto 2008; Giordano 2008; Giordano and Mazza 2010.

²⁶³ These tuffs were quarried and exploited as building stones throughout the ancient period, but especially in Rome's early history (Karner et al. 2001; Heiken et al. 2005, 37-50; Jackson and Marra 2006; Marra et al. 2011).

²⁶⁴ For geological background on the Holocene aggradation of the Tiber River valley: Campolunghi et al. 2008; Marra et al. 2013.

the time humans began to settle the hills of Rome in the second millennium BCE, the terrain posed numerous challenges to the fledgling settlement. This particular location in the lower Tiber River valley, south of the confluence with the Anio (modern Aniene) River, endured intense and often unpredictable flooding on an annual basis, a hydrological circumstance that made the valleys in the area of Rome especially prone to flooding, erosion, and sedimentation.

Despite difficulties associated with floods of the Tiber, both the ancient Romans themselves and modern scholars have affirmed the etiological view that the city of Rome sprouted in a conspicuously strategic position on the central Italian landscape.²⁶⁵ Conventional wisdom, based on inferences drawn from topographic and historical evidence, is that the city evolved at a point where the Tiber River could be crossed with relative ease, whether by ferry or at a natural ford. Although the hydrology of the Tiber River has changed over the last two and a half millennia, making it difficult to draw direct correlations between the modern and pre-urban topography, it is generally assumed that in the prehistoric era the Tiber River was navigable from its mouth at least as far as the island, the only one in the Tiber, some 25km upstream at a sharp bend in the course of the river. Here, it is thought the island acted as a natural breakwater that caused waters to dissipate, so the current immediately downstream was noticeably slower, permitting a convenient river crossing and a natural harbor in the valley at the foot of the Palatine and Capitoline Hills. Circumstantial clues, such as route of Rome's oldest roads (the Via Salaria, Vicus Iugarius, Vicus Tuscus) and the location of Rome's oldest bridge (the Pons Sublicius) are seen as early infrastructure associated with this hypothesized prehistoric river harbor and crossing in the Forum Boarium (**fig. 33**).²⁶⁶

²⁶⁵ e.g., Bloch 1960, 63-7; Toynbee 1970, 11-14; Cornell 1995, 48; Grandazzi 1997, 74-91; Meyers 2003, chap. 2. Cicero (*De re pub.* 2.10-11) and Livy (5.54) praise Romulus' wisdom for locating his city.

²⁶⁶ Platner and Ashby 1929, 574-575; Richardson 1992, 299.

A suitable river crossing, made easier by the construction of the Pons Sublicius in Rome's early history,²⁶⁷ and natural harbor would have significantly influenced the north-south and east-west movement of people, goods, and livestock in the prehistoric era.²⁶⁸ Since the Bronze Age, the Tiber River also provided access to vital natural resources at the Tiber's estuary.²⁶⁹ Salt was a crucial commodity throughout the ancient period, as it was used for nutrition, the preservation of meat, and as an early medium of exchange, an observation that provides an etymological link with the words "*salarium*" and "salary."²⁷⁰ Salt was extracted from naturally occurring saline marshes at the mouth of the Tiber,²⁷¹ before it could be conveyed by boat to the harbor in the Forum Boarium, where could be unloaded and transported by cart along the Vicus Iugarius to the Via Salaria, the oldest road leading out of Rome, which travels northeast along the Tiber River into Sabine territory.²⁷²

In general terms, Rome's locational advantages are principally related to the Tiber, and more specifically, to the opportunities afforded by a convenient river crossing and harbor on the east bank of the river in the Forum Boarium. Drawing on topographic details and literary references from the historical period, scholars have inferred that the site of Rome was situated on

²⁶⁷ Credited to the legendary fourth king of Rome, Ancus Marcius, the original construction of the Pons Sublicius is attributed to the late seventh century BCE (Livy 1.33.6; Dion. Hal. *Ant. Rom.* 3.45.2). The bridge was maintained into the fifth century CE by a college of pontiffs and is generally assumed to have crossed the Tiber from the Forum Boarium just below the later Pons Aemilius (see fig. 6; Platner and Ashby 1929, 401-402; Richardson 1992, 299; Coarelli 1992, 25-50)

²⁶⁸ Platner and Ashby 1929, 224-25; Colini 1980, 43-5; Torelli 1990, 30; Meyers 2003, chap. 5.

²⁶⁹ Coarelli has argued that the salt trade has its roots in the Bronze Age and would have made use of the harbor in the Forum Boarium (Coarelli 1992, 109-113; cf. Smith 1996, 179-180). According to later literary sources (Livy 1.32-34; Dion. Hal. *Ant. Rom.* 3.36-45), the legendary fourth king of Rome, Ancus Marcius, is said to have annexed the territory at the mouth of the Tiber and founded a colony at Ostia in the late seventh century BCE (Cornell 1995, 121, 204-208).

²⁷⁰ Waarsenburg and Maas 2001, 54-56.

²⁷¹ Giraudi 2004; Morelli et al. 2004.

²⁷² For additional background on the Via Salaria and Rome's ancient salt trade, see Platner and Ashby (1929, 574-575, 567-568); Coarelli (1988; 1992, 109-13; 2007, 425-430); Smith (1996, 179-83); Filippi (2005, 98-9). On the Vicus Iugarius, see fig. 6; Platner and Ashby (1929, 574-575); Coarelli (1992, 9-13); Virgili (1999).

an important crossroad for trade and communication in prehistoric central Italy, despite the fact that until now there has been no physical proof for the existence of a river island, crossing, and/or harbor at Rome in this era. As discussed in Chapter 3, the depth of prehistoric levels, which lie more than 10m below the modern surface, have largely impeded archaeological and geological investigations in the Forum Boarium. Using coring survey, however, I have been able to sample the natural land surface beneath the entire archaeological sequence and produce new data on the pre-urban topography of Rome's river valley. Drawing on these recent discoveries, in the present chapter I offer a preliminary reconstruction of the natural landscape of the Forum Boarium valley and some conclusions on the type and scope of human activity that once transpired in this prehistoric setting. Among other things, I provide physical evidence for a harbor in the Forum Boarium beside a previously unknown raised section of floodplain at the base of the Capitoline Hill (**fig. 34**), which formed atop a pre-existing Pleistocene alluvial terrace in this location (**fig. 35**). I also introduce new, although still inconclusive evidence, for the formation of the Tiber Island and a potential river crossing at the Forum Boarium. Subsequently, in chapter 5 I present evidence for landscape transformation associated with urban development at Rome and *emporium* activities in the Forum Boarium.

Reconstructing the pre-urban topography of the river valley

Rivers such as the Tiber encompass complex ecological systems that involve a range of hydrological forces of various scales that impact the landscape of the river valley. The specific circumstances of river flow and transport capacity are dependent upon local conditions and sediment supply, oscillating factors that influence the behavior of a riverine system both on seasonal timescales and progressively over many millennia. Prior to human intervention,

Mediterranean river valleys were dynamic and migratory,²⁷³ a reality that belies scholarly efforts to identify a singular or stagnant landscape. To account for seasonal changes in local hydrology, one objective of the present study is to produce empirical data on the pre-urban landscape of the Forum Boarium valley during normal river flow and when the Tiber was in flood. In order to interpret the complex sequence of alluvial fills in the Forum Boarium, which are the combined consequence of repeated sedimentation and erosional events, the following discussion references the extensive Earth Science literature available on riverine systems and incorporates a basic introduction of pertinent geological and hydrological details.²⁷⁴

Rivers carry water, sediment, and organic material from upland areas to lowland valleys, where sediment is deposited in alluvial contexts referred to as valley fill. The preserved stratigraphic record in the riverine system is the composite product of sedimentation and erosion. Sediments deposited as valley fill are often unconsolidated and readily eroded again into the river.²⁷⁵ These alternating forces vary considerably across the riverine system, so that areas in or near a river (including the riverbed and natural levees) are highly effected by erosion, while more stable areas adjacent to the main river channel (including the floodplain) experience sedimentation during flood events, but are less effected by erosion. Floods of the Tiber River are the natural by-product of seasonal rainfall that leads to increased surface runoff in the catchment area, causing an influx of water and sediment into streams and rivers that exceeds normal capacity. In the course of an inundation, waters rise and, if of sufficient magnitude, swell over the existing banks, before the discharge crests and waters slowly recede.

²⁷³ Vita-Finzi 1969; Brown and Ellis 1995; Brown 1997, 237–47.

²⁷⁴ The landscape reconstruction presented here would not have been possible without the input of scientific collaborators on the project, most notably C. Nicosia, F. Marra, L. Motta, and J. Sevink. Any errors are my own.

²⁷⁵ For helpful background on riverine landscapes and the processes that shape river valleys: Bridge 2003, 1-43; Freitag et al. 2009, 54-60.

In an effort to visualize the effect of floodwaters on the Forum Boarium valley, Livy provides an illustrative description of the Tiber in a peak state of flood. After the birth of Romulus and Remus, the king of Alba Longa, fearful of his hold on the throne, condemned the twin sons of his niece to be thrown in the river. Livy describes how a fortuitous flood thwarted the king's plan:

“By certain divine chance the Tiber poured beyond its banks in calm, stagnant pools and it was nowhere possible to access the course of the primary river. Those bearing the children took hope that they could be drowned by this water, however still.”²⁷⁶

Instead of being drowned as intended, the basket holding the infants was caught in the sluggish water in the floodplain before being washed back ashore, where, as the story goes,²⁷⁷ a she-wolf found and suckled the future founders of Rome. Although this is an account of a legendary event, it nonetheless provides an apt description of hydrological forces that helped to shape and define the geomorphology of the Tiber River valley. Areas closest to the river channel experience the highest energy of water flow, both during a flood and in normal hydrological regimes, while the floodplain, adjacent to the active channel, is generally calmer.

While coring in the Forum Boarium valley, it is possible to distinguish between the ancient river channel and its associated floodplain. The river's proximity to a given location is judged based on sediment size: coarse sediments exist in the river channel, slightly finer loams and sands on the natural levee that forms the riverbank, while the finest sediments (clays and silts) exist in the floodplain. Particle size is directly correlated to stream velocity, as faster water can move larger grain size and calmer water is only able to convey lighter, fine grain sizes.

²⁷⁶ Livy 1.4.4: *Forte quadam divinitus super ripas Tiberis effusus lenibus stagnis nec adiri usquam ad iusti cursum poterat amnis et posse quamvis languida mergi aqua infantes spem ferentibus dabat.*

²⁷⁷ Versions of this same myth are recounted in Ovid *Fasti* 2.390; Varro *Ling.* 5.54; Livy 1.4-7; Plut. *Rom.* 3.4; Dion. Hal. *Ant. Rom.* 1.79.1 = Cornell *FRHist* II.53. See Aldrete (2007, 10-13) for further discussion.

Although floodplains are dry during periods of normal river flow, when flood waters break over the river bank, they inundate floodplains with relatively calm waters that have less erosive power.

Before examining the landscape features of the Forum Boarium valley in greater depth, it is worth noting that these interrelated processes of sedimentation and erosion have a number of consequences for geoarchaeological investigations near rivers. First, preservation of deposits (whether natural or anthropic) is directly related to the availability of space, rate of sedimentation, and subsequent erosion. For this reason, it is unwise to expect good preservation of stratigraphy related to human activity near the river channel or natural levees, as such material has likely been washed away rather than buried and preserved, as it might be in the floodplain. Generally speaking, preservation of sedimentary structures in alluvial systems requires a micro-environment of high sedimentation and low erosion rates.²⁷⁸ Thus, this preservation bias limits the ability to recognize direct or *in situ* evidence for prehistoric human occupation of riverine systems. A second, related consequence of the hydrology is the prevalence of re-worked materials brought in by the river; regular introduction of secondary materials can contaminate younger contexts with later dates.²⁷⁹ For this reason, radiocarbon and ceramic dates within alluvial contexts should be regarded cautiously as providing only a *terminus post quem* for the deposition of alluvial sediments.²⁸⁰

²⁷⁸ Brown 1997, 39.

²⁷⁹ This is the case, for example, with ¹⁴C samples 22 and 23 from the fluvial deposits in FB 47.

²⁸⁰ Brown 1997, 58-60; Bridge 2003, 13-16.

River channel

One objective of my coring survey was to identify the position of the Tiber River prior to urban development of the landscape. As Albert Ammerman keenly recognized, virtually all representations of early Rome erroneously situate the Tiber in its modern position encased within massive retaining walls.²⁸¹ In the pre-urban era, the Tiber would have shifted freely within the river valley, changing its course and altering the shape of the river channel and banks over the millennia.²⁸² Fluvial sediments interpreted as belonging to the active river channel have been identified below 1m below sea level (mbsl) in cores FB 39, 43, 47, 48 and 49, indicating that the Tiber originally flowed as far east as the modern Via Luigi Petroselli (see **fig. 20**). Sediments in this part of the river valley are generally coarse (silts, sands, and gravels) and regularly take on a yellow-ish color.²⁸³ Often referred to in ancient sources as *flavus*,²⁸⁴ the Tiber was known for its hue, a result of the river's tawny sediment bedload.

Prior to human intervention, the Tiber River would have experienced seasonal variations while it shifted freely within its alluvial plain, depositing relatively coarse, fluvial sediments along the channel and natural levees of the river. Stratigraphically speaking, this part of the landscape is highly volatile and subject to erosion, so that the sedimentation record is often not continuous. Much of the sediment deposited in or near the active river channel would ultimately be eroded and re-deposited further downstream. Although a balanced rate of sedimentation and erosion will produce a net effect of zero inflation of the river base level, river valleys also naturally inflate with the rising sea level at the coast. As sea levels rise, rivers currents

²⁸¹ Ammerman 2013, 171.

²⁸² Bozzano et al. 2000, 7; Bridge 2003, 14.

²⁸³ In contrast to the yellow-ish Tiber sediments, deposits of darker, anaerobic fluvial sediments in boreholes FB 39 and 47 may be interpreted as local material from the Velabrum valley.

²⁸⁴ e.g., Hor. *Carm.* 1.2.13-20.

decelerate and deposit more sediment in their alluvial plains, progressively raising the base of the river channel over a geological timescale.

Using a variety of methods, geologists have reconstructed past sea levels in the Mediterranean and along the Italian coast specifically,²⁸⁵ studies which can be compared and integrated with the record of aggradation in the lower Tiber River valley from the Forum Boarium. Results of this project, specifically the sedimentary sequence exposed in boreholes FB 47 and 48, show that the rising base level of the Tiber River is coupled with the post-glacial sea level rise in the Mediterranean. The rising sea level caused the Tiber to decelerate gradually and deposit additional sediment in its channel, resulting in a progressive increase of the base level of the Tiber from ca. 5mbsl to 1mbsl during the period 2500-800 BCE. This corresponds to a modest sedimentation rate of approximately 23cm per century.²⁸⁶ Based on a combination of radiocarbon and ceramic dates from boreholes FB 39, 43, 47, 48, and 49, the base of the river channel in the late second millennium BCE can be reconstructed around 2-3mbsl, while in the early sixth century BCE, it is predictably only slightly higher, around 1mbsl.²⁸⁷ Studies of past sea levels along the Italian peninsula indicate that in the third through the first millennia BCE the Mediterranean Sea was just below the modern levels (i.e., just below 0masl).²⁸⁸ This observation is consistent with this project's reconstruction of the Tiber's base level at elevations between 5 and 1mbsl.²⁸⁹ Together, these data indicate that in the pre-urban period the Tiber's

²⁸⁵ Lambeck et al. 2004a, 2004b, 2011.

²⁸⁶ This value can be contrasted with the more rapid rate of sedimentation (roughly 9mm/year or 90cm/century) in the pre-urban floodplain, which was largely shielded from the effects of erosion, as discussed below. cf. Ammerman et al. (2000, 15) indicates that the Velabrum valley, a smaller and lower energy hydrological system than the Tiber, experienced a slow sedimentation rate (around 9cm/century) between 5000-1000 BCE.

²⁸⁷ Inferred from FB 43, 47, 48, and 49.

²⁸⁸ Lambeck et al. 2004a, 2011; Marra et al. 2008, 2013, 2016a.

²⁸⁹ Additional details on the Tiber's aggradation history and its relation to sea levels during the Holocene Epoch will be presented by F. Marra in a future publication.

channel was relatively stable, more or less equally impacted by sedimentation and erosive forces. Over the course of many seasons and years, the Tiber would have ebbed and flowed, migrating within its channel, while constantly depositing and eroding alluvial sediments, so that prior to the sixth century BCE average sedimentation rates in the Tiber River (23cm/century) were negligible on the scale of human perception.

Raised floodplain

My coring survey of the floodplain beneath the Sant'Omobono Sanctuary revealed nearly 5m of stratigraphy that alternates between settlement-related layers and fluvial deposits of the Tiber (see **fig. 29**). The distinct morphology of this sector is a fortuitous product of the Capitoline Hill, which shielded an area on its southern flank from the river's erosive forces. Here, in the location of the Sant'Omobono Sanctuary, a raised section of floodplain can be identified on the edge of the river basin in the northwestern portion of the Forum Boarium. This floodplain sits atop an even older feature of the landscape: a Pleistocene alluvial terrace, a relic of the paleo-Tiber (**fig. 35**).²⁹⁰ A geological ancestor of the modern river, the paleo-Tiber flowed at a time before volcanic eruptions blanketed the region with huge pyroclastic flows.²⁹¹ The prehistoric floodplain, in other words, overlies a pre-existing alluvial terrace at the base of the Capitoline Hill. These features, the Pleistocenic and prehistoric terraces, consist of fluvial sediment that was not subsequently eroded. Borehole SO 24, drilled at the bottom of a deep trench within the western cella at Sant'Omobono, exposed Pleistocene levels around 3masl, covered by an anthropic deposit dated by four radiocarbon samples to the late second

²⁹⁰ For general reference on the formation of such terrace features in riverine systems: Freitag et al. 2009, 55-56.

²⁹¹ Marra et al. 1998; Parotto 2008, 28-31.

millennium BCE.²⁹² Subsequently, the surface of the terrace began to be impacted by the hydrology of the modern Tiber. Since at least the late second millennium BCE, recurrent floods gradually inflated the surface in this sector by depositing mm-thick layers of silt. As the Tiber River abutted and was diverted around the western edge of the Capitoline, a section of un-eroded floodplain was left at the base of the south side of the hill (**fig. 36**).

At a rate of approximately 9mm each year,²⁹³ sedimentation as a result of recurrent overbank flooding aggraded the surface of floodplain by another 4m, so that in the early sixth century BCE the floodplain would have been noticeably higher than the rest of the river valley. A southwest-northeast profile of the Forum Boarium (**fig. 37**), illustrates the elevation disparity between the river channel and Pleistocene alluvial terrace in the late second millennium as well as that between the river channel and floodplain in the early sixth century. By the Archaic period, the surface of the floodplain had naturally aggraded to a maximum elevation of 7.5masl, forming a natural ledge that conveniently overlooked the river below. The present evidence from the boreholes suggests that there was a precipitous decline in elevation from the floodplain surface (ca. 7masl) to the riverbed below (ca. 1mbsl).

Unlike the coarse sediments found in the active river channel, the products of their high-energy environment, micromorphological and granulometric analyses demonstrate that fluvial sediments in the sector of Sant’Omobono are characterized by fine layers of silts and clays, interpreted as products of overbank flooding deposited in a relatively calm environment. The northern portion of the site that abuts the flank of the Capitolium sits on the highest part of the

²⁹² ¹⁴C samples 1-4, see also discussion below.

²⁹³ Based on the conclusion that the floodplain rose from around 3masl in the 11th century to 7.5masl by the sixth century, as demonstrated in borehole SO 24 particularly. The sedimentation rate in the floodplain can be contrasted with the slower rate of sedimentation (roughly 23cm/century or 2.3mm/year) in the pre-urban river channel, which was subject to erosive forces.

floodplain, around 7.5masl.²⁹⁴ Moving towards the south, this surface slopes down to 6masl in the area of borehole SO 18. Velocity decreases as water travels away from the river channel, so that sluggish floodwaters carry finer sediments a greater distance before dropping them on the floodplain surface. Such environments are ideal for hosting human activity, as floodplains are typically more stable and less susceptible to erosion than other parts of the alluvial plain.²⁹⁵ The preservation of undisturbed anthropogenic deposits in the floodplain, discussed below, demonstrates that this part of the landscape was markedly more stable than the rest of the alluvial plain. Whereas areas in and near the river were regularly susceptible to erasure by erosion, this sector experienced regular sedimentation and was uniquely shielded from the effects of erosion both in the Tiber River valley and in the smaller Velabrum valley.

Velabrum lowland

Although paleotopographical evidence indicates that the natural relief of the Forum Boarium valley included a section of raised floodplain, this topographic feature is confined to the base of the Capitoline Hill in the vicinity of the Sant'Omobono sanctuary. Moving towards the south, the surface gives way to lowland areas in the southern portion of the Forum Boarium. The position of cores FB 38, 39, and 40 correspond to the confluence of two valleys, the Velabrum minor (between the Capitoline and Palatine Hills) and Velabrum maior (between the Palatine and Aventine Hills; see **fig. 33**). In the Neolithic period, prior to sedentary habitation at the site of Rome, the Velabrum was characterized by a swampy formation, called an alder carr,

²⁹⁴ cf. Ammerman and Filippi 2004, 17-18. The prehistoric floodplain mimics the general N-S slope of the Pleistocene alluvial terrace (fig. 31), which was identified just below 7masl in borehole FB 42 and 3masl in SO 24.

²⁹⁵ cf. Brown 1997, 37-44.

which can be identified below 1mbsl in borehole FB 38.²⁹⁶ This calm environment of standing water produced finely laminated stratigraphy composed predominantly of very fine clay sediments. Pollen evidence collected from the lower sections of boreholes FB 38 and 40 indicates a decline in aquatic plants after the fifth millennium BCE, so that by the time humans settled at Rome, this part of the landscape was no longer permanently wet. Instead, the Velabrum valley was another active alluvial system with tributary streams that fed into the Tiber River. Unlike the raised section of floodplain at the base of the Capitoline Hill, which was shielded from erosive forces, the southern portion of the Forum Boarium was subject to erosion by the Tiber and Velabrum streams, a factor which kept the surface from naturally accreting. Beyond these incised streams, palynological evidence indicates that most of the landscape in the Velabrum would have been seasonally or periodically dry, a conclusion supported by the results of pollen analysis from the lowest sections of boreholes FB 38 and 40.²⁹⁷

Based on the available environmental evidence, it is possible to conclude that the Velabrum valley was an elevation vulnerable to regular inundation whenever the Tiber and Velabrum streams experienced elevated levels. While the southern portion of the Forum Boarium valley was likely open and dry during the summer months, increased rains during the fall and winter would have caused the Tiber River and Velabrum streams to swell sufficiently to flood the lowland for days or weeks at a time. Interestingly, multiple references in the historical record seem to confirm that this area was regularly flooded during the period of human memory, a circumstance that required the use of a ferry to permit travel from the Aventine Hill

²⁹⁶This alder carr formation was been previously identified in a coring survey of the Velabrum (Ammerman 1998; 2000; Ammerman et al. 2000, 13-15; 2008, 12; Marra et al. 2013, 161-162).

²⁹⁷ This project has confirmed and built on the results of pollen analyses performed on an earlier set of boreholes from the region (Ammerman 1998, 220-222; Ammerman et al. 2000, 2008; Ammerman and Filippi 2004). Additional details on this project's pollen analysis and data will be presented by L. Sadori in a future publication.

to the center of the city.²⁹⁸ In his etymological explanation for the name of the Aventine, Varro suggests that the word derives from *advehere*:

“For at one time the hill was cut off from the rest by swamps. They therefore used to be ferried there by rafts from the city; evidence of this is the fact that the means by which people were carried at the time is now called Velabrum and the place where they disembarked at the bottom of the Via Nova is a Velabrum shrine.”²⁹⁹

Plutarch provides a similar anecdote about ferries in the Velabrum, but rightly suggests this was a circumstance only while the river was in flood.³⁰⁰ The available evidence sheds new light on this question of a Velabrum ferry. It is clear that during the early centuries of human habitation at the site of Rome this region in the southeastern portion of the Forum Boarium was not a swamp or permanently wet zone, but seasonally wet and dry. Given its low elevation and proximity to the river, it may be hypothesized that the Velabrum valley was submerged for extended periods of time when the Tiber experienced elevated levels. Such a hydrological circumstance would have significantly complicated habitation on and communication between the hills of Rome, and it seems reasonable that early inhabitants adapted by employing a ferry to travel from between the hills during periods of elevated river levels. The first permanent construction identifiable in this part of the valley, a Tufo del Palatino and Tufo Lionato feature from 1.3 to 4.3masl in borehole FB 38, is dated to the mid-Republic. Although it is difficult to judge from a single borehole, this feature may indicate that parts of the Velabrum remained open and low into the Mid-Republican Period, so that the use of a ferry would have been necessary on a seasonal or periodic basis as late as the fourth century BCE.

²⁹⁸ Ovid *Fasti* 6.395-417; Prop. 4.9.5; Varro *Ling.* 5.43-44; Plut. *Rom.* 5.5; Cressedi 1984, 150.

²⁹⁹ Varro, *Ling.* 5.44: *Ego maxime puto, quod ab advectu: nam olim paludibus mons erat ab reliquis disclusus. Itaque eo ex urbe advehebantur ratibus, cuius vestigia quod ea qua tum advectum dicitur Velabrum, et unde escendebant ad infimam Novam Viam locus sacellum Velabrum.*

³⁰⁰ Plut. *Rom.* 5.5; cf. Aldrete 2007, 168–69.

Although the stratigraphy preserved in FB 38 seems to indicate that the pre-urban surface of the Velabrum was at a very low elevation, 1.3 masl, a number of post-depositional processes could have removed lacustrine stratigraphy associated with the fifth millennium alder carr. For example, a foundation trench for the Tufo del Palatino and Tufo Lionato feature removed geological stratigraphy related to the pre-urban surface in the Velabrum. Additionally, a pioneering study conducted by scientists from the INGV indicate that post-depositional processes, namely tectonic movement, could account for the relatively low elevation of anthropic material in the Velabrum valley. Geophysical specialists from the INGV have sampled sections of boreholes FB 39, 40, 43, and 47 in order to measure the direction and intensity of Earth's magnetic field in the past as it is preserved in the sediment of the boreholes.³⁰¹ The results of this study indicate that the tested sections in FB 38 and 40 were deposited contemporaneously, as were those in FB 43 and 47.³⁰² Analyses of the stratigraphy exposed in the lower sections of FB 38 and 40 suggests that these sediments were deposited contemporaneously and at the same elevation, only to be displaced by tectonic movement (see **fig. 31**). A matching paleomagnetic signal from different elevations in boreholes FB 38 and 40 is the first empirical evidence of tectonic displacement along a fault line in the center of Rome.³⁰³ It may be hypothesized that the local landscape was altered by faulting activity that caused the sector around FB 38 to be downshifted approximately 3m from its original position in line with FB 40. Although the paleomagnetic analysis and theory of tectonic displacement is currently being prepared for publication, these hypotheses will be more fully tested in future coring survey in the region.

³⁰¹ F. Marra, P. Macrì, and F. Florindo.

³⁰² Marra et al. 2016b.

³⁰³ Although the region is tectonically active, previous geological surveys have not exposed evidence of fault dislocation in the center of Rome (Marra et al. 1998, 62).

In summary, the evidence for the pre-urban surface level of the Velabrum is inconclusive. The elevation of the natural land surface beneath anthropic levels should either be 1.5masl or closer to 4masl. The significance of this value is discussed more thoroughly in the next section, as I attempt to reconstruct past river levels.

Hydrology

Determining water flow, river depth, and flood magnitude are particularly challenging in prehistoric contexts. Although there is ample historical evidence for floods in the ancient and modern city of Rome,³⁰⁴ these data cannot be directly applied directly to a pre-urban context, when the morphology and hydrology of the Tiber River valley was much different. Fortunately, the environmental and topographical details provided by this project provide some helpful parameters for approximating the lowest and maximum extent of Tiber river levels in the late second through the mid-first millennium BCE. For the purposes of this discussion, “normal” water flow is considered to be when the Tiber is at its lowest, presumably a circumstance that would have characterized the dry summer months when the temperate Mediterranean climate would have produced minimal rainfall. Whereas “elevated” levels refer to periods of “minor” flooding, likely a seasonal occurrence when the Tiber swelled over its banks in the rainy autumn and winter months. Lastly, “extraordinary” levels are associated with “major” floods that would have occurred less frequently during periods of especially heavy rainfall across the Tiber catchment basin, an expansive region of 16,500km² from the Apennines through Tuscany and Umbria (see **fig. 3**).³⁰⁵

³⁰⁴ Aldrete 2007.

³⁰⁵ Aldrete 2007, 51-90.

In order to draw conclusions about the hydrology of the pre-urban Forum Boarium, floodplain surface elevations denote the minimum elevation reached by flood waters. Floodplain deposits dating to the late second millennium BCE have been identified at an approximate elevation of 3masl, while the base of the river channel in this period is at 2-3mbsl, signifying a water depth of 5-6m during a flood event. By the early sixth century, the floodplain had aggraded to an elevation of approximately 7.5masl along the northern boundary of the Sant'Omobono Sanctuary, while the contemporary riverbed is positioned at an elevation of 1mbsl (**figg. 36, 37**). By these standards, floods in the early to mid-first millennium BCE reached a minimum elevation of ca. 8masl with a water depth of 9m. This conclusion finds corroboration in the Forum Romanum valley, which was the object of a massive reclamation project undertaken in the late seventh or early sixth century BCE. Anthropogenic fill deposits altered the natural relief of the basin by raising the ground level from its original elevation below 7masl to 8.6masl; this elevation was presumably successful in protecting the reclaimed valley from most contemporary floods of the Tiber.³⁰⁶ As a final indicator, the Archaic temple in the floodplain, which will be discussed at length in the next chapter, was constructed atop a stone podium that lifted the mudbrick superstructure to relative safety at an elevation of 8.2masl. It may be hypothesized that this architectural feature, the stone podium, was specifically employed in the Forum Boarium as a flood mitigating measure, intended to lift the temple's mudbrick superstructure out of reach of most floodwaters.³⁰⁷

In order to determine the elevation of the Tiber with normal water flow, the surface level of the Velabrum serves as an upper boundary, as the available paleoenvironmental evidence indicates that the southern portion of the Forum Boarium was not a permanently wet landscape

³⁰⁶ Ammerman 1990; Hopkins 2016, 30.

³⁰⁷ cf. Potts 2011.

during the pre-urban period of interest here. It can, therefore, be concluded that normal river levels did not reach the elevation of this surface, which unfortunately cannot yet be reconstructed with confidence due to inconsistencies between geological levels in boreholes FB 38 and 40, as noted above. A straightforward reading of the stratigraphy at the bottom of FB 38 would indicate that the pre-urban surface of the Velabrum was at the low elevation of 1.5masl (see **fig. 31**). In this scenario, one might assume that normal Tiber River levels in the pre-urban period were below 1.5masl. As the base of the river channel in the mid-first millennium BCE has been reconstructed around 1mbsl, this suggests that the Tiber had depth of 2m during the dry season. This reconstruction, therefore, provides some indication that the Tiber River was potentially fordable at this point south of the Tiber Island. If, however, borehole FB 38 was displaced by tectonic activity, as has been suggested by my colleagues at the INGV, it would be more reasonable to conclude that the pre-urban surface of the Velabrum valley was originally closer to 4masl. The available evidence, therefore, provides inconclusive support for the question of a fordable river crossing at the Forum Boarium, as preliminary evidence suggests that normal Tiber River levels in the pre-urban epoch may have reached as much as 5m in depth before inundating the Velabrum.

Together, these data strongly indicate that the maximum extent of floods in Rome during the late seventh and early sixth centuries was somewhere around 8masl (equating to a depth of 9m), while normal river levels could have been anywhere between 1-4masl (a depth between 2-5m).³⁰⁸ In the mid-first millennium BCE, the surface of the floodplain terrace beneath the site of Sant'Omobono stood at an elevation of 6.5-7.5masl. I suggest that this would have attracted attention as a prominent feature on the landscape, especially during dry periods

³⁰⁸ cf. Ammerman 1990, 637-638.

when the floodplain would have stood several meters above the river level. During relatively minor flood events, when the Velabrum valley may have been submerged, this section of floodplain would have been a peninsula of dry land extending from the lower, southern flank of the Capitolium.

As noted above, the question of a ford at the Forum Boarium has long been tied to the idea that the Tiber Island served as a natural breakwater that helped to slow the river current. Geological studies of the island are limited and it is unclear precisely how or when the island formed, but it may have been the product of tectonic displacement along the recently identified fault line in the Forum Boarium.³⁰⁹ Although this theory for the tectonic origin of the Tiber Island will be borne out in other publications and tested in future coring surveys, it may be hypothesized based on the chronology provided by this coring survey that the island did not exist until the 1st millennium BCE. Interestingly, Livy similarly recounts the gradual emergence of the island in living memory. He claims that after the land in the Campus Martius was consecrated, the ripe crop on the land could not be used for religious reasons, so it was cut and dumped into the Tiber at a time when the river was low:

“So the piles of grain, sticking in the shallows, settled and spread out in the mud; from this and other materials brought into the same spot, which the river brings at random, an island was gradually formed.”³¹⁰

While Livy does not provide a clear date for this event,³¹¹ which in any case would be several centuries before his lifetime, the scenario can be interpreted as part of Rome’s etiological mythology. Whenever and however the island originated, Livy’s description of alluvial

³⁰⁹ Evidence for a fault line and tectonic activity possibly related to the formation of the Tiber Island will be addressed in an upcoming publication with my colleagues at the INGV, F. Marra, P. Macrì, and F. Florindo.

³¹⁰ Livy 2.5.2-4: *Ita in vadis haesitantis furmenti acervos sedisse inlitos limo; insulam inde paulatim et aliis, quae fert temere flumen, eodem invectis, factam.*

³¹¹ Also recounted in Dion. Hal. *Ant. Rom.* 5.13.

processes is accurate; the island likely experienced gradual surface inflation over time, just as we see in other parts of the river valley. Once the island had reached sufficient size, it would have served as a natural breakwater at this already strategic bend in the Tiber River.

Towards a visualization of the pre-urban landscape

The available evidence indicates an exceptional and dramatic setting, difficult to imagine in light of the modern topographical homogeneity of the area. In the pre-urban period, we have to envision the sheer cliff of the Capitoline Hill rising some 40m over the river in the valley below. More than 30m below this peak, emerged a shoulder from the south side of the Capitoline, the original Pleistocene terrace with levels of subsequent accretion that created a raised section of floodplain. This floodplain surface gradually sloped downwards, towards the south, until it met the low level basin of the Velabrum, from the modern Vico Jugario down to the Temple of Portunus. The floodplain would have been visually prominent both from the river and the lower areas of the Velabrum; based on reconstructed river levels, the eroded, western face of the floodplain stood as high as 6m above the surface of the Tiber river. Thus the Velabrum valley was an access point to the river, while the floodplain terrace would have provided a strip of dry, semi-protected land immediately adjacent to the river.

Although evidence for the existence of the river island and ford in the prehistoric era is inconclusive, I argue that the available topographical and environmental evidence provides additional support for the theory that the Forum Boarium marked an important river crossing. At this unique point in the Tiber River valley, the alluvial plain widened at the confluence of two minor tributary valleys, thus providing extra accommodation for waters to spread and dissipate. This topography would have made it easier to navigate between the Velabrum and the

western bank of the Tiber with relative ease.³¹² Sailors who navigated the Tiber, whether in low or elevated periods, would find the water current slower here in a semi-protected natural harbor where the river widened at the Velabrum valley before turning westward around the Aventine Hill. Shallow-bottomed vessels require as little as 1m of water to maneuver,³¹³ suggesting that the pre-urban Forum Boarium could have operated as a harbor even during the dry season when the Tiber was low. This harbor can be identified with some certainty in the area beneath the modern Palazzo dell'Anagrafe, based on historical references,³¹⁴ topographical clues,³¹⁵ and a new discovery: evidence for dredging activity, which I present in depth in the next chapter.³¹⁶

The birth of Rome: a hut settlement on the Capitoline Hill

The available archaeological record indicates that humans began to settle at the site of Rome in the course of the second millennium BCE. Although artifacts dating to the early and mid-second millennium BCE have been sporadically found at Rome, the material is exclusively attributed to secondary contexts,³¹⁷ which makes it difficult to prove conclusively the existence of a permanent settlement at the site during the Early or Middle Bronze Ages. More reliable evidence for consistent sedentary habitation has been dated to the final centuries of the second millennium BCE. Notably, excavations at the site of the Giardino Romano on the Capitoline Hill

³¹² cf. Colini 1980, 43-45.

³¹³ Marriner and Morhange 2006, 167.

³¹⁴ In his account of the mid-fifth century, Dionysius of Halicarnassus (*Ant. Rom.* 9.68.2) describes a harbor capable of supporting large ships at a wide part of the Tiber in the vicinity of the Pons Sublicius. Varro (*Ling.* 6.19) mentions the existence of a *portus* in the vicinity of the Temple of Portunus, which is generally identified with the ionic temple on the north side of the Piazza della Bocca della Verità (Platner and Ashby 1929, 430-31; Colini and Buzzetti 1986b; Richardson 1992, 320; Buzzetti 1999a; Coarelli 2007, 315-318). See also discussion in Chapter 1.

³¹⁵ In particular, the orientation of the Temple of Portunus and the Archaic temple at Sant'Omobono.

³¹⁶ Gapped stratigraphy in boreholes FB 48 and 49 has been interpreted as the result of dredging activity beginning as early as the fifth century BCE and continuing at least through the mid second century BCE (see chapter 5).

³¹⁷ Peroni 1962; 1971, 177-179; Carafa 1996, 792-793; Carandini 2006, 60; Angle and Guidi 2007, 151.

have exposed levels associated with Bronze Age habitation, including some terracing features created during a reorganization of the north slope of the Capitolium in the 13th century BCE.³¹⁸ Contemporaneous interventions were utilized in the valley northeast of the Capitoline, where excavators in the Forum of Caesar have identified similar efforts to raise and flatten the sloping land.³¹⁹ Extrapolating from limited excavations and the scattered recovery of Bronze Age material, most scholars posit that by the mid-second millennium BCE Rome consisted of a settlement on the Capitoline Hill, and possibly another on the adjacent Palatine.³²⁰ Comparisons with peer settlements in central Italy in this period show a preference for defensible hilltops,³²¹ while funerary activity was largely relegated to the lowlands. As a prominent characteristic of Latin culture, burials were typically separated from habitation zones and are therefore often interpreted as an indication of settlement boundaries.³²² Cremation burials in the Forum of Caesar have been dated to the 11th-10th centuries BCE,³²³ providing further corroboration for the proximate existence of a stable settlement. Additionally, three skeletons found during excavations at the so-called *Equus Domitiani* in the Forum Romanum have been dated to the late second millennium BCE, but interpretation of this deposit remains problematic and these dates should accordingly be regarded with caution.³²⁴

Although early excavations at the Sant'Omobono Sanctuary produced a substantial quantity of both imported and local ceramics dating from the Middle Bronze Age to the Early

³¹⁸ Baroni 2001; Cazzella 2001, 267; Lugli and Rosa 2001. For a summary of securely dated late second millennium deposits at Rome, see Brock and Terrenato (2016, 654-656).

³¹⁹ De Santis et al. 2010, 261-262.

³²⁰ The earliest occupation levels exposed on the Palatine Hill (from excavations at the so-called Hut of Romulus) date to the early 1st millennium BCE. Coarelli 1992, 112; Carandini 1997, 126-127; Cazzella 2001; Filippi 2005, 98-100; Cazzella et al. 2007; Fulminante 2014, 69-72.

³²¹ Cazzella et al. 2007, 808; Alessandri 2013, 15, 29-53; Fulminante 2014, 175-177.

³²² De Santis 2001; Fulminante 2014, 67.

³²³ De Santis et al. 2010, 263-272.

³²⁴ Gjerstad 1953, 49-52; Filippi 2008, 634; Gusberti 2008, 648.

Iron Age, these materials were found exclusively in secondary contexts, mixed within the fill of the early fifth century BCE platform.³²⁵ Like so much prehistoric material found in secondary contexts, this served to confirm the presence of humans at Rome in the Bronze Age, but did little to clarify the size or scope of settlement activities beyond the worthy acknowledgement that Rome was connected to wider Mediterranean trade routes from as early a date. There has been ample scholarly debate on whether the Bronze and Iron Age sherds from Sant’Omobono should be interpreted as evidence of settlement activity on the Capitoline or as remnants of an early *emporium* on the Tiber.³²⁶ Whatever the sherds’ provenience, I hope this work makes a sufficient case for the latter hypothesis.

For the first time, recent explorations with coring survey have permitted investigation of the floodplain beneath Sant’Omobono. Boreholes SO 22-26 revealed the existence of anthropic deposits covering the Pleistocene alluvial terrace (described above), which sits roughly 4m below archaic levels at the site. Repeated but limited sampling of this discovery revealed a series of three anthropogenic deposits intercalated with layers of fluvial sediments deposited by overbank flooding of the Tiber (see **fig. 29**).³²⁷ Micromorphological analysis, a process that involves examining a thin section of sediment under a petrographic microscope,³²⁸ of these deposits revealed a sharp boundary between the anthropogenic and alluvial sediments that showed no signs of soil formation or bioturbation, which might be expected if the landscape was exposed and developed naturally over time; the stratigraphy is, therefore, indicative of a fast-accreting sequence, rather than a result of progressive formation processes. The anthropic

³²⁵ Peroni 1962. See discussion of platform in Chapter 5.

³²⁶ Coarelli 1992, 112; Carafa 1996, 792-793; Carandini 1997, 113; Filippi 2005, 100-101; Angle and Guidi 2007, 172-174; Cazzella et al. 2007, 805; Bartoloni 2009, 95.

³²⁷ A preliminary interpretation of boreholes SO 22-26 was first presented in Brock and Terrenato 2016, since revised in light of new evidence.

³²⁸ For a general reference on soil micromorphology: Courty et al. 1989.

remains were primarily composed of domestic waste, including the disposed food preparation remains and kitchen waste, abundant charcoals, charred cereal grains, darkened phytoliths, excrements and latrine waste, and earth-based construction materials such as mud plaster. Six small ceramic fragments were vaguely dated to the Bronze Age-Iron Age transition. Indications of re-working and morphologies with rounded edges indicate that some or all of the materials originated on the Capitoline and could have washed downslope as colluvium.³²⁹ Radiocarbon analysis of four charred cereal grains from the highest and lowest of these anthropic deposits returned dates in the late second millennium BCE,³³⁰ synchronous with evidence of settlement activity on the Capitoline Hill, discussed above.

Interpretation of these deposits at the base of the Capitoline permit a number of conclusions. On the conservative side, these deposits provide further evidence for a stable settlement on the Capitoline Hill, which began to noticeably impact the local landscape in the 13th-11th century BCE. Moreover, it is possible that these deposits are the result of direct human intervention in the valley that could have involved backfill or dumping of mixed materials from settlement contexts, but such a hypothesis will require testing in future coring surveys. Unfortunately, the narrow window of visibility (five boreholes drilled at the bottom of a single deep trench) complicates thorough investigation of the spatial extent of these deposits, which would help determine details related to their formation. For now, this discovery beneath Sant'Omobono represents one of the few stratified Bronze Age deposits found in Rome, providing additional evidence for the scale of human activity at Rome in the late second millennium BCE. Subsequently, floods of the Tiber buried these deposits and gradually inflated the surface level of the floodplain by several meters.

³²⁹ Nicosia 2017.

³³⁰ ¹⁴C samples 1-4.

Conclusions: envisioning the prehistoric harbor in the Forum Boarium valley

The paleoenvironmental details brought to light by this project have led to new inferences regarding the natural relief of the Forum Boarium valley as well as the form and function of Rome's first river harbor. The natural harbor and river crossing, both features which have been corroborated by the results of this project, would have attracted an abundance of prehistoric human activity to the future site of Rome. The natural topography would have acted as a funnel, drawing people from various directions to this strategic valley. Sailors from the Mediterranean who ventured into the mouth of the Tiber in search of a natural harbor, which was otherwise absent along the coast,³³¹ would have to sail 25km upriver before encountering the Forum Boarium. Similarly, resources and people coming down river would find a convenient stopping place here, before continuing to the Tiber's estuary, which contained copious salt resources. The Tiber, moreover, acted as a natural boundary that delineated the regions of Etruria and Latium, so that east-west movement of people and livestock between these two regions would have been limited by the fordable or ferry-worthy river crossing at the Forum Boarium. Such a landscape, fertile with ready access to fresh water, would be ideal for shepherding and grazing livestock, likely a common occurrence in the pre-urban period and one that is echoed in the valley's distinctive name, "cattle market."

It is now apparent that the paleotopography of the Forum Boarium was especially unique, an *unicus locus* that is the distinct product of the local geomorphology. It can be concluded that the topography of the valley provided ample space for an abundance of human activity near the Tiber River. Coring in this region, predictably, revealed no evidence of paved surfaces or constructions from the pre-urban era; as the majority of the valley was low and

³³¹ Prior to the construction of port facilities at Ostia, the closest natural harbor can be found in the Bay of Naples, at the site of Puteoli.

regularly impacted by the hydrological regime of the Tiber, the region could feasibly support only temporary or seasonal anthropic presence. Lacking more advanced construction technologies,³³² the early inhabitants of Rome may have invested in temporary structures built of mudbrick and timber in the floodplain. If so, such readily available materials could have made it possible to rebuild quickly and cheaply following an inundation.³³³

Although floods certainly posed a threat to life and property, the early inhabitants of Rome were undoubtedly accustomed to the cyclical nature of the Tiber and modified their activities to permit a seasonal presence in flood-prone parts of the lowlands.³³⁴ During calm periods when the river was low (1-2m deep) and remained within its channel, it can be safely assumed that an abundance of human activity took place in the valley, both in the Velabrum and on the floodplain at the base of the Capitolium. Although it is difficult to prove definitively human occupation of the Forum Boarium prior to the sixth century BCE, the available paleotopographic evidence suggests that both the Pleistocene alluvial terrace and subsequently the prehistoric floodplain were prominent features on the pre-urban landscape that could have supported a variety of river-related activities by providing a convenient place where people and materials were protected from much of the Tiber's destructive force. Not only was this area uniquely shielded from erosion, but the elevation of the floodplain surface—hypothesized to be as high as 6m above normal river levels in the mid-first millennium BCE—would have offered protection from all but major floods in the region. Flood waters that did reach this upper most part of the river valley would have much reduced energy, such that their destructive force would

³³² For discussion of building materials and methods in early Rome: Cifani 2001, Hopkins 2016.

³³³ Comparanda are found in the Malay-Indonesian archipelago during the 13th-15th centuries CE. Research has shown that mercantile centers were situated at river mouths and exposed to seasonal flooding (Wink 2002, 428–29). These villages, which were built of bamboo and dried mud, were repeatedly destroyed and rebuilt in a matter of days.

³³⁴ cf. Ammerman 1990, 636-638; Aldrete 2007, 39-50.

be mitigated. The primary danger from inundations of sufficient magnitude to submerge the floodplain would have been the deposition of fine sediments dropped by the floodwaters, potentially a nuisance but little more. There is no reason to expect that inundations caused a significant loss of human life in the prehistoric era, as people could take refuge on the hills whenever the Tiber began to swell. Despite the predictability of Tiber floods and the lack of immediate dangers, there remains the possibility of secondary health issues associated with stagnant water in the valley,³³⁵ likely a regular occurrence in the lowland of the Velabrum valley after a flood.³³⁶

Even without the construction of formal port facilities, which would otherwise be jeopardized by recurrent floods, early harbors were simple and required little if any engineered infrastructure to operate effectively.³³⁷ In his account of Archaic Rome, the Roman historian Dionysius of Halicarnassus describes how large vessels docked at the mouth of the Tiber and unloaded their wares onto smaller river boats:

“The Tiber descends from the Apennine mountains, flowing past Rome itself, and empties into the harborless and exposed shores that the Tyrrhenian Sea creates... but it is of sufficient size to allow even large sea-worthy trading vessels to sail up to Rome itself, and for large river boats to navigate all the way to its sources. He [Ancus Martius] determined to build a sea-port at its outlet, using the mouth of the river itself as a harbor. For the river widens greatly when joined with the sea and forms great bays, which are the best kinds of sea harbors. But, what is most amazing, it is not shut off from its mouth by piled sandbars, to which even many large rivers suffer... Therefore, oared ships, of whatever size they happen to be, and towed ships bearing up to 3,000 measures, enter at its mouth and are conveyed to Rome itself by oar or towed by cable. But larger

³³⁵ Transmitted by mosquitoes that breed in wet areas, malaria is one such hazard in flood-prone regions, although there is not yet empirical proof of the disease’s existence in early Rome. Strabo (5.3.5) describes parts of Latium as marshy and sickly (ἐλώδη καὶ νοσερά). Varro (*RR* 1.12.2) even offers a warning about *animalia quaedam minuta* that breed in marshy areas, suggesting at least a rudimentary awareness of health issues associated with stagnant water. For archeological evidence of malaria in ancient Italy: Soren and Soren 1995; 1999; Sallares 2002, 105. For background on the presence of malaria in ancient and modern Italy: Jones 1907, 73; Sallares 2002, 66–8; 204; Snowden 2006, 7–52; Weiland 2011.

³³⁶ See discussion of the Cloaca Maxima in chapter 5.

³³⁷ cf. Delano Smith 1978, 26–27, Purcell 1996, 268–69.

ships riding at anchor at the mouth are loaded and unloaded by river boats. The king built and fortified a city in the bend between the river and the sea, which he named Ostia from its position, just as we would call it “Door.”³³⁸

Although Dionysius authored his text in the first century BCE and was likely describing practices and methods of boating in his own day,³³⁹ this account remains informative.

Prehistoric shipping technology and river navigation would have operated similarly, albeit on a smaller scale.³⁴⁰ Vessels capable of sailing the Tiber and stopping at the Forum Boarium valley would have been propelled by a combination of sail and oarsmen or towing along the bank.³⁴¹

In the early centuries of human occupation at the site of Rome, it may be hypothesized that shallow-bottomed boats were dragged onto dry sections of the gently sloping Velabrum lowland. Such a scenario would permit merchants to berth their boats and unload wares even in an era prior to the development of permanent port infrastructure.

In sum, the available evidence supports the conclusion that the Forum Boarium valley was a major node of trade and communication in prehistoric central Italy. Rome’s strategic position is the result of natural processes that continued to shape the landscape of the Forum Boarium into the late second and early first millennia BCE, so that the river valley was

³³⁸ Dion. Hal. *Ant. Rom.* 3.44.1-4: τοῦ γὰρ Τεβέριος ποταμοῦ καταβαίνοντος μὲν ἐκ τῶν Ἀπεννίνων ὄρων, παρ’ αὐτὴν δὲ τὴν Ῥώμην ῥέοντος, ἐμβάλλοντος δ’ εἰς αἰγιαλοὺς ἀλιμένους καὶ προσεχεῖς, οὓς τὸ Τυρρηνικὸν ποιεῖ πέλαγος... ἱκανοῦ δὲ ὄντος ἄχρι μὲν τῶν πηγῶν ποταμηγοῖς σκάφεσιν εὐμεγέθεσιν ἀναπλεῖσθαι, πρὸς αὐτὴν δὲ τὴν Ῥώμην καὶ θαλαττίαις ὀλκάσι μεγάλαις, ἐπίνειον ἔγνω κατασκευάζειν ἐπὶ ταῖς ἐκβολαῖς αὐτοῦ λιμένι χρησάμενος αὐτῷ τῷ στόματι τοῦ ποταμοῦ. εὐρύνεται τε γὰρ ἐπιπολὺ τῇ θαλάττῃ συνάπτων καὶ κόλπους λαμβάνει μεγάλους, οἷους οἱ κράτιστοι τῶν θαλαττίων λιμένων: ὁ δὲ μάλιστα θαυμάσειεν ἂν τις, οὐκ ἀποκλείεται τοῦ στόματος ὑπὸ τῆς θαλαττίας θινὸς ἐμφραττόμενος, ὁ πάσχουσι πολλοὶ καὶ τῶν μεγάλων ποταμῶν... αἱ μὲν οὖν ἐπὶ κωποὶ νῆες ὀπηλίκαι ποτ’ ἂν οὔσαι τύχωσι καὶ τῶν ὀλκάδων αἱ μέχρι τρισχιλιοφόρων εἰσάγουσι τε διὰ τοῦ στόματος αὐτοῦ καὶ μέχρι τῆς Ῥώμης εἰρεσία καὶ ρύμασι παρελκόμεναι κομίζονται, αἱ δὲ μείζους πρὸ τοῦ στόματος ἐπ’ ἀγκυρῶν σαλεύουσαι ταῖς ποταμηγοῖς ἀπογεμίζονται τε καὶ ἀντιφορτίζονται σκάφαις. ἐν δὲ τῷ μεταξὺ τοῦ τε ποταμοῦ καὶ τῆς θαλάττης ἀγκῶν πόλιν ὁ βασιλεὺς ἐντειχίσας, ἣν ἀπὸ τοῦ συμβεβηκότος Ὠστίαν ὠνόμασεν, ὥς δ’ ἂν ἡμεῖς εἵπομεν θύραν.

³³⁹ See Gabba (1991, 60–92) for discussion of Dionysius’ methods and historical veracity.

³⁴⁰ Blackmann 1982, 90–4.

³⁴¹ Casson 1965, 32; Colini 1980, 46. When the Tiber was at a high level, it is possible that even larger ships could have navigated its waters.

characterized by three significant features: raised floodplain overlooking a harbor and river crossing. Contemporaneous with the natural evolution of the floodplain in the Forum Boarium, it is clear that a permanent settlement was established on the Capitoline Hill by the Late Bronze Age. The advantages provided by the natural landscape likely enabled the settlement to be a seat of regional power and wealth even in the prehistoric era. From its birth, in essence, Rome was an *emporium*. To capitalize on the benefits afforded by their river harbor and control regional trade routes, however, the early Romans were compelled to urbanize a disparate, dynamic, and often inhospitable landscape, a complex undertaking that required considerable resources and communal organization. Their decision to erect a city on these hills would ultimately result in a complete transformation of the landscape of the Tiber River valley.

Chapter 5

Urbanizing the Landscape: The development and decline of Rome's original river harbor

Coring survey has provided evidence that the natural relief of the Forum Boarium valley was characterized by a prominent floodplain terrace that extended out from the base of the Capitoline Hill and overlooked a natural harbor and river crossing at a bend in the Tiber River. In the early decades of the sixth century, the inhabitants of Archaic Rome installed a permanent edifice in the floodplain: an ornate mudbrick temple seated atop a tall stone podium. While in its early years this temple would have been largely protected from the threat of floodwaters, new discoveries show that as Rome urbanized over the course of the sixth century, floods and sedimentation in the valley became markedly more intense, significantly complicating harbor operations and jeopardizing the associated temple. I interpret this phenomenon of increased flooding and sedimentation as the direct result of increased human activities on the local landscape. From the late seventh through the early fifth centuries BCE, the archaeological record show that Rome was visibly characterized by large-scale landscape modification projects and the transition to monumental architecture that involved a gradual increase in stone-based constructions. The sixth century, in essence, marks the time when Rome ceases to be a hut settlement and becomes a city.

It is becoming increasingly apparent that in order to urbanize, the Romans were forced to adapt to an often volatile landscape. Whereas their Bronze Age and Iron Age predecessors inhabited a relatively stable setting, with relatively predictable seasonal flooding, Romans of the sixth century were plagued by floods and the continual accumulation of sediment in their harbor. This hydrological shift may have been a direct consequence of the relatively sudden, but nonetheless significant intensification in local deforestation to support new construction and a burgeoning population. The results of this project are, therefore, shedding light on the role of humans as geomorphic agents in the ancient Mediterranean.³⁴² The Romans, both directly and intentionally as well as indirectly and unintentionally, transformed the landscape as they urbanized. This chapter argues that commercial opportunities and ecological pressures in Rome during the mid-first millennium BCE prompted complex socio-political responses aimed at urbanizing the landscape while simultaneously maintaining operations around the river harbor in the Forum Boarium. This multifaceted human-environment relationship, perhaps more than anything else, appears to have guided the shape and function of the built landscape of the emergent city.

Early Archaic Period: a city rises

Sometime in the late seventh or early sixth century BCE, the inhabitants of Rome embarked on a series of ambitious building projects. The first was a reclamation project aimed at raising the ground level in the Velabrum valley between the Capitoline and Palatine Hills (see **fig. 32**); a terracing wall was constructed across the Velabrum and up to 20,000 cubic meters of

³⁴² cf. Hooke 2000; Gregory 2006; Di Rita et al. 2010; Walsh 2014.

fill was dumped into the low lying basin.³⁴³ This monumental enterprise, which undoubtedly required ample civic corporation, raised the surface by nearly 2m to an elevation of 8.6masl. It seems likely that this was a deliberate choice intended to protect the region from floodwaters, which could reach up to 8masl in the early sixth century.³⁴⁴ This investment in land reclamation provided new civic space for the growth of ritual and bureaucratic facilities that would go on to characterize the Forum Romanum.

Likely in conjunction with this reclamation project in the northeastern portion of the Velabrum, the Cloaca Maxima, Rome's oldest sewer,³⁴⁵ was installed to help drain this valley. In its original version, the sewer was likely an open channel that encased the natural stream that flowed through the Velabrum to the Tiber.³⁴⁶ The recent paleoenvironmental reconstruction of the Forum Boarium explains the circuitous course of the drain, noted for its sinuosity,³⁴⁷ which is less than ideal as bends in the course of the drain would slow the water and cause periodic blockages. In actuality, the Cloaca Maxima traveled from the Forum Romanum, around the raised floodplain at the base of the Capitoline, and through the lower Velabrum valley, where it intersected the Tiber River in the southern Forum Boarium. Before it was vaulted and buried, the drain probably originally consisted of a canalized version of the natural stream that already

³⁴³ This reclamation theory was first proposed by Ammerman (1990). Hopkins (2016, 27-34) expands upon Ammerman's conclusions by offering a convincing reconstruction of the project. Although the terracing wall is not mentioned in the literary record and has never been identified archaeologically, it is nonetheless presumed to exist, likely somewhere beneath the Basilica Iulia, because some kind of terrace feature would have been necessary to hold back the artificial fill in the upper Velabrum valley. Such construction methods—terracing to raise or level a sloping surface—are attested at Rome as early as the late second millennium BCE (cf. Lugli and Rosa 2001; De Santis et al. 2010, 261-262). On the volume of fill, see Wiseman (2008, 2).

³⁴⁴ Inferred in part from the upper limit of the floodplain surface, which is around 7.5masl. See full discussion in Chapter 4.

³⁴⁵ Livy 1.38.6.

³⁴⁶ Hopkins 2012a, 84-85.

³⁴⁷ Holland 1961, 349-350. Hopkins (2012a, 87-88) assumes that the drain meandered because it followed a predetermined path that the Romans would not or could not change, even when the drain was rebuilt in later periods; the results from the present study serve to confirm his theory.

existed in the Velabrum valley;³⁴⁸ among other things, this project would have helped to keep the rest of the basin dry. Albert Ammerman's cores in the Velabrum uncovered evidence of a manufacturing district in the region 100m east of the Sant'Omobono and southwest of the Forum Boarium (**fig. 17**), where there are natural deposits of fine clay buried beneath the anthropic sequence at approximately 3.5masl. Chemical analysis has demonstrated that these thick clay beds were exploited for the purposes of tile production in Rome during the late seventh and early sixth centuries BCE, indicating that the natural (yet un-reclaimed) lowland in the Velabrum was occupied, at least in part, with production activities related to the tile trade.³⁴⁹ At an elevation of 3-7masl, such manufacturing activities would benefit from their proximity to the harbor, but operations would have been subject to seasonal floods of the Tiber.

Construction of Rome's first harbor temple

Although the Forum Boarium valley appears to have hosted only seasonal or intermittent human activity for the first few centuries of human habitation at the site of Rome, the first identifiable attempt at establishing a permanent presence in the floodplain occurs when the Romans build a temple here in the early sixth century BCE. Excavations at the Sant'Omobono Sanctuary have provided tantalizing glimpses of this structure, including a stone podium, altar,³⁵⁰ and assortment of lavish architectural sculptures associated with at least two building phases in the sixth century BCE.³⁵¹ Although the superstructure would have consisted of mudbrick and timber, which do not survive, scholars have reconstructed a *distyle in antis*

³⁴⁸ Hopkins 2007; 2012a, esp. fig. 5.2.

³⁴⁹ The clay beds were identified in Velabrum cores 3, 4, 8, and 9 (see fig. 17), positioned atop stratigraphy associated with the sixth millennium alder carr (Ammerman et al. 2008; cf. Hopkins 2016, 61-62).

³⁵⁰ Diffendale et al. 2016, 13.

³⁵¹ Hopkins 2016, 66-84; Brocato et al. 2016

Tuscan temple.³⁵² It was thought that the temple faced southwest towards the harbor, which has been identified on the basis of historical references as well as other topographical clues, discussed in Chapter 1. Add to this list the discovery of dredging activity, presented for the first time here, and it is possible to locate the original harbor of Rome in the vicinity of the modern Palazzo dell'Anagrafe with some certainty.

Drawing from limited material found at the Sant'Omobono site and scant references in the literary record, previous attempts by scholars to visualize Rome's archaic harbor have been based more on conjecture than archaeological or topographic evidence. As noted earlier, Giovanni Ioppolo's sketches from 1989 position the Archaic temple at Sant'Omobono directly on the bank of the river (**figg. 9, 10**), position that would have surely left the mudbrick temple completely exposed to floods of the Tiber.³⁵³ Lorenzo Quilici's model of archaic Rome, built in 1990 and once on display at Museo della Civiltà Romana,³⁵⁴ depicts a formal harbor with artificial docks with a pair of harbor temples (**fig. 11**). Much of Quilici's visualization of the harbor in the Forum Boarium is fanciful, including the existence of a second Archaic temple and the regularized dockyards,³⁵⁵ which would have been impractical prior to the invention of hydraulic concrete in the mid-second century BCE.³⁵⁶

New paleotopographical details uncovered by the current project advance a more evidence-based reconstruction of Rome's river harbor and harbor sanctuary in the Forum Boarium. As the first identifiable component of port infrastructure emerging around the natural

³⁵² For discussion of the architecture and chronology of the archaic temple: Diffendale et al. 2016, 10-14; and Brocato and Terrenato 2017.

³⁵³ *Il Viver Quotidiano in Roma Arcaica* 1989, fig. 3, tav. 1.

³⁵⁴ Quilici 1995; D'Amato 1997.

³⁵⁵ See Diffendale et al. (2016, 20) on the question of a second Archaic temple to match the twin temples present at the Republican sanctuary.

³⁵⁶ Mogetta 2015.

harbor, this temple building would have commanded a dominant position on the landscape. Situated on the floodplain surface at roughly 6.5m, the 1.7m high podium was constructed of an unusual variety of Tufo del Palatino (see **figg. 16, 22**), harder and more compact than the lower-quality version known as *cappellaccio*.³⁵⁷ The recent paleoenvironmental reconstruction of the region indicates that in the early sixth century BCE, the mudbrick temple, situated atop its stone podium at an elevation of 8.2masl, would have been relatively safe from floodwaters. Velocity diminishes as water spreads out from the river channel during floods, so it is likely that even major inundations would have slowly engulfed the podium without causing significant damage to the mudbrick temple or the cult materials housed within. As one of the earliest podia known from Italy,³⁵⁸ this topographical reconstruction adds credence to the theory that such architecture was employed as a flood mitigating feature in lowland areas such as the Forum Boarium.³⁵⁹

The raised floodplain and harbor temple, therefore, offered a commanding view of the Tiber River and sailors arriving at the shore of Rome. The Early Archaic sanctuary is generally attributed to the cult of Fortuna, based on references in the historical record and the goddess' role in the later Republican sanctuary;³⁶⁰ certainly she was an apt figure for a harbor shrine, as sea travel and cultural amalgamating in the ancient Mediterranean was often perilous and unpredictable. Such investments in ritual pursuits reflect complex state formation processes operating in sixth century Rome; as one of their first major undertakings in the construction of their city, the early inhabitants of Rome made a conscious decision to erect a permanent construction in the floodplain and imbue their river harbor with a divine presence.³⁶¹ Indeed,

³⁵⁷ Diffendale et al. 2016, 11-12.

³⁵⁸ Potts 2015, 40-42; Hopkins 2016, 56-63; Diffendale et al. 2016, 10-19; Brocato and Terrenato 2017.

³⁵⁹ cf. Potts 2011.

³⁶⁰ Dion. Hal. *Ant. Rom.* 4.27.7; Livy 5.19.6. See also discussion in chapter 1.

³⁶¹ cf. Terrenato 2011; Lindenhout 2014, 127; Hopkins 2016, 62-63.

there existed a close relationship between ancient harbor and religious spaces,³⁶² as documented in central Italy at sites such as Pyrgi and Gravisca, and throughout the Mediterranean. Since harbors represent a liminal space where locals and foreigners regularly interact, the gods were likely seen as an important mediary presence.

A new challenge: floods and sedimentation

Not long after the construction of the Archaic harbor temple, the Forum Boarium valley experienced a substantial transformation due to a rapid sedimentation in the river channel. Over the course of a single century, several meters of fluvial sediment were deposited in the alluvial plain, reaching an elevation of 7.3masl in borehole FB 39 and 9.1masl in FB 43, before being covered with anthropic deposits dating generally to the mid-Republic (**figg. 30, 31**). The situation in FB 47, positioned just off the western edge of the Sant’Omobono excavation area, is particularly illustrative. In this borehole, the fluvial sediment is covered by a Tufo del Palatino and Lapis Albanus feature, which extends from 4.9 to 7.4 masl and should likely be associated with the Late Archaic overhaul of the Sant’Omobono sanctuary, which was carried out with identical materials.³⁶³ The discovery of this tuff feature in FB 47 not only hints at the existence of a lower terrace or paved surface at the base of the early fifth century platform (discussed below), but also conveniently provides a *terminus ante quem* for the deposition of 5.8m of sediment in the alluvial plain over the course of a single century (ca. 580-480).

When contrasted with the negligible rate of sedimentation in the pre-urban river channel (ca. 23cm/century), this represents a remarkable surge in the Tiber’s sediment bedload and a dramatic change in the hydrological conditions of the river valley well beyond the bounds of

³⁶² Riva and Stoddart 1996; Demetriou 2012.

³⁶³ Diffendale et al. 2016, 22.

seasonal nuisance flooding (**fig. 38**). By the end of the sixth century, the riverbed had risen to 5masl, nearing the same altitude as the floodplain surface where the Archaic temple was situated. By the mid-Republican period, continued sedimentation raised the alluvial plain to an elevation of 9masl. This alluviation reshaped the valley's topography and would have had considerable implications for a functioning harbor and cult center, as floods would have become increasingly problematic. The historical record makes it abundantly clear that the Romans long struggled against flooding and the Tiber's saturated sediment bedload,³⁶⁴ which caused the length of the lower Tiber River and estuary to silt up repeatedly in the ancient period. By the Late Republic, the censors, whose purview included public works projects at Rome, regulated the Tiber through new bureaucratic offices, *curatores riparum*, who were charged with oversight of the Tiber and its banks.³⁶⁵ Before delving further into the practical considerations for harbor management, however, it is necessary to explore possible causes for this consequential uptick of sediment in the Forum Boarium beginning in the sixth century BCE.

Explaining the sedimentation

The Forum Boarium coring survey revealed a rich sedimentary archive from the last 13 millennia of the Tiber River valley's history. Amounting to more than 50m of stratigraphic record, core FB 48 drilled through a deep sequence of alluvial sediments deposited by the Tiber as a direct result of a rising sea level in the Holocene. As sea levels rise, river currents decelerate and deposit sediment in their alluvial plains, progressively rising the base level of the river channel over a geological timescale. During the period from 2500–800 BCE, this progressive

³⁶⁴ Aldrete 2007, 123-128; Strabo 5.3.5; Suet. *Aug.* 30; *CIL* 14.85.

³⁶⁵ Tac. *Ann.* 1.76; Dio 57.14.7-8; Suet. *Aug.* 37; *CIL* 6.31540 = *ILS* 5922; *CIL* 14.5320. See discussion in Aldrete (2007, 198-203).

silting of the Tiber's channel occurred at an average rate of 23cm per century, as previously stated, inflating the riverbed from around 5mbsl to 1mbsl (see **fig. 38**).³⁶⁶ The landscape in this pre-urban period was relatively stable and the product of balanced rates of sedimentation and erosion in the river channel, which produce a net effect of zero sedimentation. Based on the alluvial record, therefore, the landscape of the Tiber River valley was equally impacted by sedimentation and erosional forces while gradually rising with the sea level, so that sedimentation in the river channel was negligible during the early centuries of human occupation at the site of Rome.

Although the Bronze Age and Early Iron Age inhabitants of Rome likely experienced predictable, seasonal flooding of the lowlands, the results of this study suggest that the hydrology changed dramatically sometime in the early to mid-sixth century BCE. An accelerated rate of sedimentation in the lower Tiber River valley began to outpace erosional forces in the vicinity of the Forum Boarium, a fact perhaps exacerbated by diminished water velocity at this point in the Tiber, presumably due in part to a number of circumstances, including the growing Tiber Island and a widening of the alluvial plain at the confluence with the Velabrum valley. Consequently, the Tiber's channel filled rapidly with fluvial sediments, constituted by predominantly yellow silts with frequent cm-thick fine sand layers. This pronounced sedimentation is identifiable in cores drilled along the eastern edge of the river channel, namely boreholes FB 39, 43, and 47, where the base level in the Early Archaic period was around 1mbsl and by the Late Archaic period has inflated to nearly 5masl. As the dramatic increase in sedimentation is not reflective of contemporaneous sea level rise,³⁶⁷ which might otherwise suggest a natural cause, the evidence instead suggests a pronounced change to the hydrology of the Tiber basin.

³⁶⁶ Based on boreholes FB 47 and 48. See also discussion in Chapter 4.

³⁶⁷ Lambeck et al. 2004.

Beyond sea level transgression, which can be ruled out as a causal factor, there are at least two other potential natural sources for the substantial package of sediment deposited in the Forum Boarium. First, a substantial increase in sediment supply may reflect an important climatic shift in the region, involving significant increase in rainfall and, therefore, surface runoff and flood events. Global and regional climate records, however, do not hint at such a climatic event in this period. Alternatively, tectonic movement could create a new accommodation space in the river valley for the introduction of new alluvial sediment. Italy is, of course, a seismically active region,³⁶⁸ and preliminary analysis of the Forum Boarium boreholes has provided some indication of tectonic activity in the region in the first millennium BCE.³⁶⁹ Specifically, magnetostratigraphic analysis on two sections of alluvial sediment in FB 38 and 40 suggests the occurrence of post-sedimentary displacement as a result of faulting activity. This tectonic slip may have caused a sudden collapse of the alluvial plain, creating additional space for the accumulation of sediments, as well as the origination of the Tiber Island in the sixth century.³⁷⁰ While this fault hypothesis will be examined in future research, it is worth noting here that preliminary results indicate that the tectonic uplift was in the magnitude of ca. 3m, which would help explain part, but not all, of the 10m pack of sediment deposited in the Forum Boarium since the Early Archaic period.

To explicate fully the deposition of nearly 5m of sediment in the Forum Boarium over the course of a single century, it is necessary to consider various anthropogenic factors. Identifying

³⁶⁸ For a modern perspective on Italy's changing landscape and challenges with urbanization, see Severgnini 2016.

³⁶⁹ Fault displacement of Holocene alluvial sediments of the Tiber River have been previously documented in the coastal alluvial plain (Ciotoli et al. 2016).

³⁷⁰ This hypothesis is based on work currently being carried out by F. Marra, F. Florindo and P. Macri of the INGV in Rome. These collaborators have conducted a novel magnetostratigraphic study of FB 38, 40, 43, and 47 to map the paleomagnetic signal preserved in comparable sedimentary sequences. The results of the study and the implications for faulting activity will be presented in an upcoming article.

cause and effect relationships in human-environment interactions, however, can be tenuous and problematic. Many variables, related to both natural and manmade causes, effect landscape change, and attempting to evaluate these dynamics based on a limited set of data in a prehistoric context makes the task of accurately identifying and describing these complex processes even more difficult. In the case of early Rome, there are many circumstantial clues that can aide the interpretation, but definitive proof is limited. Despite this note of caution, I argue based on evidence presented here that the documented 10m of sedimentation in the Forum Boarium is a result, at least in part, of a marked increase in human activity on the local landscape since the Early Archaic period.

Previously, scholars have contended that large-scale anthropic intervention in the Tiber drainage basin was initiated in the mid-Republican period.³⁷¹ This argument rests primarily on the literary record, which documents an apparent peak in the frequency of flood events between 200 BCE and 200 CE, a phenomenon that has been explained with assumptions of intensive deforestation in the region during the third century BCE,³⁷² ostensibly when Rome first required ample timber to construct a fleet to oppose Carthage in the Punic Wars. Recent discoveries in the Forum Boarium, however, are strongly suggestive of large-scale anthropic interventions in the Tiber basin immediately upriver from Rome beginning in the sixth century BCE, an argument that is predicated in part on the documented surge in urban growth that occurs in Rome at this time. The apparent “peak” in documented floods between 200 BCE and 200 CE is an artificial

³⁷¹ Ward-Perkins (1962, 391) argues that large parts of Etruria were still forested at the beginning of the fourth century BCE, when the Romans began to expand northwards. Meiggs (1982, 223-246) suggests that Etruria was largely deforested by the end of the Republic. Strabo (5.2.5) mentions that forests as far as Pisa were being exploited in the early first century CE in order to produce the timber required for constructions in Rome.

³⁷² Delano Smith 1979, 278-279; Hughes and Thirgood 1982a, 69-70; 1982b, 202; Aldrete 2007, 74-77; Horden and Purcell 2000, 324-341, 604-605.

product of the available literary record, and should not be taken as a representative sample or indicative of flood frequency and magnitude in earlier periods.

There is vast literature on the impact of early agriculture and deforestation on sediment transport and rapid aggradation of coastal areas and river valleys.³⁷³ Deforestation and the conversion of land for agriculture in the Tiber River valley would have certainly caused an increase in erosion and surface runoff, factors which escalate the volume of both sediment and water entering the river.³⁷⁴ Although geology provides a strong basis for the correlation between deforestation and sedimentation, arguing a direct cause and effect relationship between these two variables is challenging, particularly because the former can only be studied circumstantially. Lacking a contemporaneous literary record, pollen data collected from sediment cores and archaeological layers can provide proxy evidence for deforestation and agricultural development by demonstrating a decline in tree species and corresponding rise of cultivated plants. Central Italy is unusually productive for palynological studies, since pollen grains can be preserved and collected from lacustrine deposits in a number of existing and drained crater lakes. Pollen is the product of complex climatic factors and anthropic activity, making it difficult to assess whether a shift in plant taxa are a result of natural or manmade changes on the landscape,³⁷⁵ but recent studies offer some insights into the growing presence of humans on the central Italian landscape in the late Holocene. A palynological study conducted on sediment boreholes collected from the Grosseto alluvial plain in southern Tuscany has provided evidence for consequential human impact from the ninth century BCE onwards. Specifically, the study identified a decrease in

³⁷³ Examples of such recent studies in Italy include Brown and Ellis (1995); Piccarreta et al. (2011); Borrelli et al. (2014).

³⁷⁴ Hughes and Thirgood 1982a; Harris 2013; Thommen 2012, 79-89.

³⁷⁵ Williams 2000; Mercuri and Sadori 2014, 510-513.

deciduous forest and introduction of cultivated plants.³⁷⁶ Similarly, sediments collected from Lago dell'Accesa in Tuscany preserve signs of human impact around a sixth century BCE Etruscan settlement, including pollen indicators for a reduction of forested area and increasing values of arable crops and other anthropic markers.³⁷⁷ Although these studies cannot be applied directly to the situation at Rome, they lend weight to my own hypothesis by providing some regional comparanda for similar deforestation and agricultural activities occurring in central Italy during the Early Iron Age and Archaic Period. In the case of the Forum Boarium coring survey, pollen samples were collected from lacustrine sediment in boreholes FB 38 and 40, contexts that predate the origins of sedentary habitation at Rome. As one would expect, the upper sections of these deposits have been disturbed by later fluvial and human activities, thereby destroying the delicate pollen record.

Given that we lack palynological data from Rome in the first millennium BCE, the case for deforestation must be made from other evidence. Fortunately, the archaeological record for this period is robust and provides some indication of the scale of human activity on the landscape. From the late seventh to the early fifth century, a plethora of new building projects are undertaken in Rome, marking the transformation from hut settlement to city. These projects that have been confirmed with archaeological investigations include:

1. Fill and paving of the Forum Romanum valley (including the Cloaca Maxima)
2. Early Archaic harbor temple at Sant'Omobono
3. Regia
4. Temple of Castor
5. Temple of Saturn
6. Atrium Vestae
7. A monumental platform at the site of the Comitium
8. Capitoline Temple, including terracing on the southern slope of the Hill
9. Late Archaic platform and twin temples at Sant'Omobono
10. Elite homes on the north slope of the Palatine

³⁷⁶ Biserni and Geel 2005.

³⁷⁷ Drescher-Schneider et al. 2007.

11. First phase of the villa at the Auditorium site
12. Sections of the so-called Servian wall³⁷⁸

These structures employ stone on a scale not previously seen, a fact that reflects the prominence and presumably the intended permanence of these buildings. This list, particularly when considering the dearth of solid-built, permanent constructions in Rome prior to the Archaic period, indicates a watershed moment of urbanization in the sixth century BCE. Over the course of a single century, communal organization at Rome engaged in large-scale landscape modification and construction projects, transforming the landscape from disjointed hilltop hut settlement to cohesive urban center. As far as it is possible to surmise intent, it seems that deliberate decisions were finally made to tame their incongruent environment and lift themselves away from nuisance floodwaters.

If this surge in physical urban development reflects a comparable population growth at Rome—a hypothesis that is unprovable but nonetheless logical—deforestation would have been imperative to provide building materials and fuel.³⁷⁹ Although the ancients themselves recognized a connection between deforestation and flooding,³⁸⁰ there is no evidence from the literary record that indicates the scope of logging activities or the timber trade,³⁸¹ something that would nonetheless provide little indication of such occurrences in earlier periods. Nonetheless, a growing population and communal labor force (not to mention soldiers)³⁸² would have undoubtedly required an agricultural surplus to provide food for the burgeoning urban center. It

³⁷⁸ The extent and date of the wall circuit continues to be debated (Hopkins 2016, 92-97). See Hopkins (2016, 39-152) for a recent comprehensive survey and discussion of building projects in Rome from 650-450 BCE.

³⁷⁹ Fuel could account for up to 90% of the demand for wood in premodern contexts (Hughes and Thirgood 1982a, 61).

³⁸⁰ Pliny *NH* 31.30.

³⁸¹ Meiggs 1982, 377.

³⁸² While building their city in the Archaic Period, the Romans were simultaneously expanding their territory into Latium (Smith 2007b, 170-176).

is therefore possible to argue that in order to support and maintain the well-documented urban growth in Archaic Rome, considerable land must have been deforested and, at least some, subsequently exploited for agricultural and pastoral pursuits.

The relationship between Rome and agricultural exploitation of her hinterland has long interested and perplexed scholars, who have approached the subject largely in later periods when a historical record exists and can be complemented with more robust archaeological evidence.³⁸³ Field survey provides the most reliable picture of rural settlement patterns in the prehistoric period, and such studies in southern Etruria and Rome's suburbia have demonstrated population growth and an expansion of cultivation in this period.³⁸⁴ Also worth noting are the remains of a villa at the Auditorium site in northern Rome, the first phase of which dates to the mid-sixth century BCE.³⁸⁵ While direct evidence for deforestation and farming in the hinterlands of Rome in the sixth century is limited, numerous studies and models have demonstrated the inverse correlation between population density and forest cover.³⁸⁶

In sum, lacking applicable climatic or natural explanations for the documented sedimentation in the Forum Boarium over the course of the sixth century, it is reasonable to interpret this shift in the hydrological regime of the Tiber as a result of intensive deforestation occurring simultaneously with the growth of the city.³⁸⁷ Logging activity would have been (at least initially) focused on the valleys immediately upriver from Rome, and sediment would have

³⁸³ For discussions of Rome's hinterland in the Late Republic and Early Imperial periods, see Morley (1996) and Witcher (2005).

³⁸⁴ Potter 1979, 72-74; Carafa 2004; Patterson et al. 2004, fig 3.

³⁸⁵ Terrenato 2011.

³⁸⁶ Mather et al. 1998; Williams 2000. Kaplan et al. (2009, 3018-3019, tab. 3) incorporate historical population data, technological innovation, and land suitability to establish a model for deforestation in prehistoric Europe, estimating that the percent of forest cover on usable land in Italy drops from 69% in 1000 BCE to 51.1% in 500 BCE.

³⁸⁷ Investigations in the harbor at Marseilles have similarly documented an increased sedimentation rate corresponding to the foundation of the city (Marriner and Morhange 2006, 167).

been released, washed downslope into the river, and eventually deposited in the lower stretches of the Tiber alluvial plain. Logging operations would have likely focused on areas within a relative proximity to the river, as timber could be easily conveyed downstream to Rome.³⁸⁸ Deforestation and the conversion of land for agricultural and pastoral activities would have been required to feed the growing population at Rome and provide resources and construction materials for the monumental task of engineering the development of a city.³⁸⁹

Late Archaic Period: adaptation and renovation

Although the Archaic temple at Sant'Omobono was originally built at a relatively secure elevation above the river, the results of the Forum Boarium coring survey indicate that over the course of the sixth century the cult site became increasingly susceptible to floodwaters. By the end of the century, the river channel had filled with sediments to 5masl, nearing the floodplain surface and the temple building itself. Although the early inhabitants of Rome were undoubtedly accustomed to seasonal, nuisance flooding, this sedimentation and presumably the floodwaters that brought it were a new, unforeseen challenge, likely a direct consequence of their substantial undertakings on the local landscape. By the late sixth to the early fifth century BCE, ecological pressures associated with flooding and sedimentation compelled the Romans to adapt and react to protect their harbor temple and maintain shipping activity.

³⁸⁸ Strabo (5.3.7) mentions the importance of the Tiber and its tributaries transport for stone and timber resources. Meiggs (1982, 377) asserts that the problem of transport limited the exploitation of forests in the ancient world; transport by river was by far the most economical method.

³⁸⁹ Although there is ample ceramic evidence of Rome's participation in regional and Mediterranean exchange networks since the second millennium BCE, it seems unreasonable to conclude that the early city could subsist on imports alone. Clearly, the inhabitants of Rome readily exploited their local landscape for the production of food and building materials.

As a seeming initial endeavor, there is indication that extra effort was made to protect and maintain the Archaic harbor temple on the floodplain surface. During excavations in deep trench D10 at the Sant’Omobono sanctuary, an interesting ca. 1m tall clay feature was exposed immediately west of the archaic podium. Clearly not formed by natural processes, the clay feature was found to contain abundant ceramic materials and may be tentatively interpreted as an artificial levee wall built to protect the temple from floodwaters. Although further explorations at the Sant’Omobono sanctuary and ongoing research being conducted by the Project’s team will better clarify the context and chronology of this unique feature, it is nevertheless apparent that by the early fifth century the situation in the floodplain was untenable. Nearly 6m of sediment had accumulated in the alluvial plain just below the base of the Archaic harbor temple. With less accommodation space, there can be little doubt that floodwaters threatened the mudbrick temple. At this point, the Romans relented; they abandoned their ornate temple in the floodplain and completely overhauled the region.

Renovation of the harbor sanctuary

By the late sixth century, the Archaic harbor temple was abandoned, and the Romans commenced a massive building project aimed at lifting the surface level in the floodplain. Constructed atop the natural surface of the floodplain at 7masl, a 6m tall platform was erected against the lower flank of the Capitoline Hill (**fig. 36**).³⁹⁰ This large platform supported the new

³⁹⁰ This structure is commonly referred to as a “podium” or more specifically the Republican podium at Sant’Omobono (cf. Diffendale et al. 2016). I opt for Potts’ (2015, 39) definition of a “platform,” which contrasts with a podium in that a platform has a large size discrepancy between superstructure and substructure. This is a matter of semantics, but for the purposes of this project I distinguish the Early Archaic podium from the Late Archaic platform.

harbor shrine, now consisting of twin temples attributable to Fortuna and Mater Matuta.³⁹¹ The two goddesses are especially apt for a harbor setting, Matuta being the mythological mother of the port god Portunus, and Fortuna being the goddess of fortune and good luck.³⁹² In essence, this monumental construction that characterizes the Sant'Omobono sanctuary recreated and formalized the original, archaic topography of the region. Where once a natural floodplain terrace overlooked the harbor, the Late Archaic renovation of the harbor sanctuary established a new, artificial terrace that stood at an elevation of 13masl, 6m above the riverbed below. The site's physical and symbolic relationship to the river and the surrounding floodplain was therefore reestablished.

The platform's exterior perimeter walls, measuring about 47m on each side, was constructed of ashlar blocks of locally-quarried Tufo del Palatino and Lapis Albanus stones (see **figg. 16, 23**).³⁹³ A tuff feature made of identical materials was revealed from 4.9 to 7.4masl in borehole FB 47 at the western edge of the Sant'Omobono site, a discovery that hints at the presence of a lower terrace at the base of the platform, possibly constructed to reinforce the exposed side of the floodplain or even provide some mooring structures around the harbor. Within the platform's stone façade, the interior largely consists of thick sedimentary deposits, amounting to an estimated total volume of 7000-10,000 m³ of sediment.³⁹⁴ These fill deposits were extracted from at least two local sources and transported to the Sant'Omobono sanctuary for disposal within the platform. A portion of the platform's construction fill is comprised of dark, tuff-rich deposits, interpreted as products of quarrying on the nearby hilltops. In the sixth century

³⁹¹ Livy (33.27.4) mentions the existence of Republican temples of Fortuna and Mater Matuta in the Forum Boarium.

³⁹² Ovid *Fasti* 6.545-548.

³⁹³ Farr et al. 2015; Diffendale et al. 2016, 21-32.

³⁹⁴ Diffendale et al. 2016, 24-25; cf. Ioppolo 1972, 17.

especially, Tufo del Palatino was intensely quarried from pyroclastic deposits within the hills of Rome,³⁹⁵ in order to supply a plethora of new construction across the city (see list above).³⁹⁶ Undoubtedly, such quarry activity would have produced a great deal of refuse, which would have been conveniently repurposed as fill during construction on the nearby platform at Sant'Omobono. In addition to this material from the hills, the platform also contains considerable deposits of yellow silt with a relative dearth of anthropic inclusions, comparable to alluvial sediment found in abundance in the surrounding landscape. In contrast to the sedimentary record of the alluvial plain, which has a similar consistency but typically displays distinctive horizontal lenses characteristic of primary alluvial deposition, the platform's construction fill lacks such cohesive, horizontal stratigraphy. Exhibiting characteristics of post-depositional disturbance and secondary displacement, these silt deposits within the platform are interpreted as sediment extracted from the riverbed and redeposited here. For the purposes of structural fill, such alluvium would have been readily available and likely was the by-product of dredging in the harbor.

Dredging activity

Direct evidence for dredging in the Forum Boarium was first revealed during the 2015 mechanized coring survey of the region. Unlike the thick pack of sediment dating to the Archaic period, which is identifiable above 1mbsl in boreholes FB 39, 43, and 47, there is a conspicuous absence of this stratigraphic sequence in FB 48 and 49 (**figg. 30, 36**). Borehole FB 48 shows signs of a chronological hiatus at 0.4mbsl, covered by fluvial sediments with rare inclusions of pozzolanic ash and dated to the third century BCE by one sherd and one radiocarbon date.

³⁹⁵ Ammerman and Terrenato 1996; Heiken et al. 2005, 7.

³⁹⁶ Jackson and Marra 2006; Cifani 2008, 221-222.

Borehole FB 49 displays a clear hiatus at 1mbsl, covered by alluvium with frequent *pozzolana* and mortar inclusions as well as several Republican sherds. As these two indications of hiatus are not reflective of any regression in sea level curves, which would otherwise imply that the gapped stratigraphy is the result of a natural erosion, they can be interpreted as the result of anthropic intervention, presumably periodic dredging of silt from the harbor basin.

Although there is an ample textual record of dredging in Rome during the Late Republic and Imperial periods,³⁹⁷ this project provides the first sound evidence for dredging in the Forum Boarium as early as the Late Archaic period. The practice is believed to have originated in the Bronze Age in Egypt and Mesopotamia,³⁹⁸ and direct evidence for dredging has been identified at numerous ancient ports in the Mediterranean, including Marseille,³⁹⁹ Naples,⁴⁰⁰ Sidon,⁴⁰¹ and Tyre.⁴⁰² Additionally, dredging activity dating to the fourth century BCE is well documented in the Piazza Municipio in Naples, where large scouring marks in the tuff substratum of the harbor testify to the work of digging machines.⁴⁰³ Harbor navigation for small vessels requires a water depth of at least 1m;⁴⁰⁴ this would have been a difficult standard to maintain in the harbor of the Forum Boarium from the sixth century BCE onwards, when sedimentation rates spike considerably (see **fig. 38**).

The gapped stratigraphy in FB 48 and 49 indicates the presence of dredging and therefore serves as confirmation for the precise placement of the harbor itself. This discovery corroborates

³⁹⁷ Aldrete 2007, 123-128; Suet. *Aug.* 30; *CIL* 14.85.

³⁹⁸ Fabre 2004/5.

³⁹⁹ Morhange et al. 2003. In the ancient harbor at Marseilles, three dredging boats dating to the first-second centuries CE have been unearthed.

⁴⁰⁰ Giampaola et al. 2004.

⁴⁰¹ Marriner and Morhange 2005; Marriner et al. 2006.

⁴⁰² Marriner and Morhange 2006; Marriner et al. 2008.

⁴⁰³ Marriner and Morhange 2006, 167; Morhange and Marriner 2010, 26-28, fig. 4.

⁴⁰⁴ Marriner and Morhange 2006, 167.

other topographic clues that indirectly signal the location of the harbor, including the orientation of the Early Archaic temple at Sant’Omobono and the Temple of Portunus. Moreover, the topographic features of the region in the historical period preserve memories of the pre-urban landscape. The harbor basin, for example, separates the traditional boundaries of the Forum Holitorium and Forum Boarium.⁴⁰⁵ The former region is identified with the sector outside the Porta Carmentalis in the Campus Martius, while the latter specifically referred to the stretch of land between the Aventine and Capitoline Hills (see **fig. 6**).⁴⁰⁶ Nominally dividing the two riverside Fora, the harbor also served as the destination (or origination) of the Vicus Iugarius, one of the oldest thoroughfares in Rome that linked the Forum Romanum to the harbor.⁴⁰⁷ When the totality of evidence is considered together, including literary references, topographic signals, and evidence for dredging, it is possible to identify with confidence the original position of the harbor of Rome beneath the Palazzo dell’Anagrafe.

The documented sedimentation in the region during the sixth century would have undoubtedly complicated boating activity in the harbor, necessitating regular maintenance. It may be reasonably hypothesized that dredging of the harbor basin began as early as the fifth century, if not earlier. Additional confirmation for the commencement of dredging activity can be found in the platform at Sant’Omobono. Some of the early fifth century fill I interpret as

⁴⁰⁵ For simplicity, this project refers to the entire region as the Forum Boarium valley. The northern part of the valley, immediately west of the Capitoline Hill, is sometimes identified as the Forum Holitorium or “vegetable market” (see **fig. 6**)

⁴⁰⁶ When Augustus divided the city into 14 administrative districts, this project’s study area was assigned to three different regions: the Forum Boarium included with the Circus Maximus in Region XI, while the Forum Holitorium was grouped with the Circus Flaminius in Region IX, and the Sant’Omobono Sanctuary was considered part of the Forum Romanum in Region VIII.

⁴⁰⁷ Boreholes SO 36 and 32 have revealed the gravel shoulder of the Capitoline Hill at 7.5masl along the northern boundary of the Sant’Omobono Sanctuary; this natural feature could very well have served as a natural surface for the Vicus Iugarius (cf. Ammerman 2000). Borehole FB 41 exposed a basalt surface with mortar at an elevation of 15masl, which is interpreted as the imperial version of the same street.

disturbed alluvial sediment,⁴⁰⁸ removed from the adjacent river channel and deposited within the platform. After dredging, alluvial sediment would have re-filled the area, necessitating repeated dredging events. The coring survey documents sedimentation in this part of the valley through the second century BCE,⁴⁰⁹ suggesting that regular maintenance was required to permit normal operations in the Forum Boarium harbor at least through this period.⁴¹⁰

On the whole, evidence for dredging activity and the massive renovation of the harbor sanctuary are a testament to the labor and civic coordination employed to maintain Rome's river harbor in the Forum Boarium. As this construction represents a substantial public investment in permanent floodplain occupation and safeguarding a ritualized landscape, it therefore reflects the perceived socio-economic importance of the river harbor in Late Archaic Rome. Upon completion of the sanctuary in the early fifth century BCE, the new, twin harbor temples were situated atop the platform at 13masl, an elevation that would have protected them from most contemporary inundations.⁴¹¹ Towering over the Tiber River and floodplain, this sanctuary complex transformed the natural landscape of the valley and undoubtedly contributed to the city's impressive urban façade. As foreign merchants sailed up the Tiber and stopped at Rome's harbor in the Forum Boarium to unload their wares, the harbor sanctuary would have seemed an impressive edifice and monumental backdrop for commerce and cultural amalgamating.

⁴⁰⁸ On the platform fill, see Diffendale et al. (2016, 24-25) and discussion above.

⁴⁰⁹ As the Tiber River valley was progressive deforested, the consequence of sedimentation in the Forum Boarium may have reduced over time. In this scenario, the upper part of the catchment basin may store the released sediment for some time, before gradually the sediment reached lower areas of the river valley. This theory on the proximity of deforestation may help explain why the sixth century (when we might assume that deforestation occurred on the local landscape) marks significant sedimentation in the Forum Boarium, but this sedimentation rate seems to dissipate over the next few centuries.

⁴¹⁰ Post-archaic sedimentation identifiable in FB 42, 44, 45, 46, 48, 49 and SO 30.

⁴¹¹ cf. Aldrete 2007, 61-66.

Republican Period: maintenance and abandonment of the harbor

Although the early fifth century renovation of the Sant'Omobono sanctuary would have likely protected the Republican twin temples from most floods, the Tiber did not relent, but continued to silt up the river channel and inundate the lowlands of the city.⁴¹² Fluvial deposits dating to the mid-Republic have been identified as high as 11.5masl in boreholes FB 42, 43, 44, 45, 46, and 48,⁴¹³ and the literary record documents the occurrence of floods as high as 20masl by the Augustan period (see **fig. 13**).⁴¹⁴ It is likely that continued urbanization and deforestation in the Tiber catchment basin through the Republican Period would have exacerbated floods and sedimentation throughout the river valley.⁴¹⁵ Unfortunately for the ancient inhabitants of Rome, who endeavored to contain the Tiber, the urbanization process itself had a direct and intensifying effect on floodwaters.⁴¹⁶ As buildings and pavement crowded the lowlands over time, floodwaters would have less accommodation space, being forced into smaller spaces with limited drainage, thereby increasing their depth. As the Romans adapted to inundations by modifying their building practices and reclaiming low-lying areas, flood levels continued to rise and threaten the city.

The historical record is abundantly clear that the Forum Boarium valley, and the city as a whole, was never completely safe from floods of the Tiber. Livy recounts a series of catastrophes that hit the Forum Boarium from the late third through the early second centuries, including major floods in 202, 193, 192, and 189 BCE and major fires in 213 and 192 BCE.⁴¹⁷ By this

⁴¹² Based on borehole FB 43.

⁴¹³ cf. Ammerman (1998, 219) has identified Tiber flood sediments identified up to 10masl in the Velabrum cores.

⁴¹⁴ Aldrete 2007, 83.

⁴¹⁵ Meiggs 1982, 221-227; Hughes and Thirgood 1982.

⁴¹⁶ Aldrete 2007, 87-89.

⁴¹⁷ Floods: Livy 30.38.10-12; 35.9.2-3; 35.21.5-6; 38.28.4; fires: Livy 24.47.15; 35.40.8.

point, harbor maintenance would have been an increasing nuisance, while Rome's demand for ships and *emporium* space was growing exponentially. As a result, the Romans invested in a new harbor space in the open plain immediately south of the Aventine Hill in the modern Testaccio district (**fig. 39**).⁴¹⁸ Livy mentions that the aediles of 193 BCE oversaw construction of “one portico outside the Porta Trigemina with an *emporium* added near the Tiber.”⁴¹⁹ As the Porta Trigemina is thought to have existed in the southern Forum Boarium,⁴²⁰ the textual record indicates that in the early to mid-second century BCE simultaneous investments were being made in Forum Boarium *emporium* while infrastructure was being erected in a new *emporium* immediately south of the Aventine Hill, including paving and the construction of a stairwell from the *emporium* on the Aventine to the Tiber.⁴²¹ The censors of 179 BCE were especially prolific, as Livy records a series of riverside projects that stretch from the Forum Boarium to the Testaccio region:

“M. Fulvius put in place additional projects of greater utility: a harbor (*portum*) and pylons for a bridge over the Tiber—on which after some years P. Scipio Africanus and L. Mummius, censors, arranged the construction of arches—a basilica behind the new shops of the silversmiths and a fisherman's market, surrounded by shops, which he sold for private use; also a portico beyond the Porta Trigemina, another behind the dockyards (*navalia*), at the shrine of Hercules, behind the temple of Spes on the Tiber, and near the shrine of Apollo Medicus.”⁴²²

⁴¹⁸ Aldrete 2007, 192-198; Coarelli 2007, 345-346.

⁴¹⁹ Livy 35.10.12: [Lucius Aemilius Lepidus and Lucius Aemilius Paulus] *porticum unam extra portam Trigemina, emporio ad Tiberim adiecto, alteram a porta Fontinali ad Martis aram, qua in Campum iter esset, perduxerunt.*

⁴²⁰ Coarelli (1992, 25-34) locates the Porta Trigemina in the southern Forum Boarium (see fig. 6).

⁴²¹ Livy 41.27.8-9 (174 BCE): *Et extra portam Trigemina emporium lapide strauerunt stipitibusque saepserunt, et porticum Aemiliam reficiendam curarunt, gradibusque ascensum ab Tiberi in emporium fecerunt.*

⁴²² Livy 40.51.4-6: *M. Fulvius plura et maioris locauit usus: portum et pilas pontis in Tiberi, quibus pilis fornices post aliquot annos P. Scipio Africanus et L. Mummius censores locauerunt imponendos; basilicam post argentarias nouas et forum piscatorium circumdati tabernis quas uendit in priuatum; et porticum extra portam Trigemina, et aliam post naualia et ad fanum Herculis et post Spei ad Tiberim <et ad> aedem Apollinis medici.*

Livy reports that work on a harbor (*portus* not *emporium*) occurred in the vicinity of the Pons Aemilius, which crosses the Tiber at the Forum Boarium (see **fig. 6**); this brief comment may imply dredging of the harbor or other investments in other port infrastructure. Additional constructions were erected in the southern part of the Forum Boarium (*extra portam Trigemina*), the northern part of the Forum Boarium (*post fanum Spei ad Tiberim*),⁴²³ and behind the dockyards (*post naualia*). The recent identification of *naualia* with a large *opus incertum* structure located south of the Aventine (the so-called Porticus Aemilius) confirms the presence of port infrastructure in the Testaccio region from the late second century BCE.⁴²⁴ By this point, the construction of dock facilities benefitted greatly from the invention of hydraulic concrete, which revolutionized port architecture by facilitating more secure and abundant infrastructure in wet environments.⁴²⁵

As commercial shipping was progressively redirected to the newly established *emporium* beyond the Aventine Hill, the harbor in the Forum Boarium was eventually abandoned sometime after the mid-second century BCE. It appears that the Romans ceased dredging in the area around borehole FB 48, which is further east and contains third century sherds and rare inclusions of pozzolanic ash, some generations before they stop dredging at FB 49, which contains frequent *pozzolana* and mortar inclusions and several Republican sherds. This dichotomy between boreholes FB 48 and 49 may reflect two distinct phases of harbor maintenance. It may be hypothesized that building activity in the Forum Boarium, whether after a major flood or during

⁴²³ The Temple of Spes from San Nicola in Carcere (see fig. 6), one of three Republican temples built beside the river in the Forum Holitorium.

⁴²⁴ Cozza and Tucci 2006; Tucci 2012; D'Alessio 2014; Mogetta 2015, 13-14; cf. Tuck 2000; Coarelli 2007, 345.

⁴²⁵ cf. Vitruvius (5.12.2) for harbors lacking natural advantages and the method of building walls under water; also Vitruvius (5.12.7) on the importance of not building *naualia* from wood. For further discussion, see Gazda 2001.

work on the *portus* in 179,⁴²⁶ reinforced or regularized the harbor, leaving less space to be dredged in subsequent generations. Although the textual record indicates that the Forum Boarium underwent a variety of reconstruction efforts in the late third and early second centuries BCE,⁴²⁷ coring survey provides only limited visibility on such construction events, as specific architectural features can be difficult to infer from a single borehole. The Tufo del Palatino and Tufo Lionato feature from 1.3 to 4.3masl in borehole FB 38 may be associated with Mid-Republican building activity. Given the position of this core and the low elevation of this deposit, either this tuff feature was deposited within a foundation trench that obliterated earlier stratigraphy (also difficult to determine from a single core)⁴²⁸ or this part of the valley (i.e., the southern portion of the Forum Boarium, which is intercepted by the Velabrum valley) remained open and very low as late as the fourth century BCE.

As there is no evidence for concrete architecture in Rome before the middle of the second century BCE,⁴²⁹ the final accumulation of mortar-rich alluvium in borehole FB 49 must date no earlier than this period. After the final dredging event, alluvium filled the harbor basin up to an elevation of approximately 6masl, before the Romans filled and built up the rest of the district. Discoveries made during archaeological investigations at the Palazzo dell'Anagrafe seem to

⁴²⁶ Livy 40.51.4-6, see discussion above.

⁴²⁷ After the fire of 213 BCE, the twin temples of the Sant'Omobono Sanctuary were reconstructed (Livy 25.7.5-6; Diffendale et al 2016, 34-36.)

⁴²⁸ It remains possible that a foundation trench for this tuff feature removed stratigraphy associated with the fifth millennium alder carr (see Ammerman 1998, also chapter 4 of this work), which would mean that the surface level in the Velabrum was originally higher. At first glance, comparing the stratigraphy in the lower section of borehole FB 38 with FB 40 provides some indication that the lacustrine deposits reached up to 4masl. Recent paleomagnetic investigations of these deposits (Marra et al. 2016b), however, have revealed that the landscape was altered by faulting activity that caused the sector around FB 40 to be uplifted. To correct for this hypothetical fault displacement, FB 40 must be shifted 3.2m downward with respect to its original elevation. Although evidence for tectonic displacement will be presented in future publications, the interpretation presented here accepts the hypothesis. From a construction perspective, moreover, it would not be necessary to dig a foundation trench, as the lacustrine clay would have provided a flat, stable surface upon which to build.

⁴²⁹ Mogetta 2015.

corroborate the timeline for the reclamation of the harbor in the Forum Boarium. Excavations in 1936-1937 revealed Trajanic warehouses in the area.⁴³⁰ Uncovered in the southern part of the Trajanic complex, a single wall of *opus quadratum* in Grotta Oscura tuff has been identified as predating the imperial construction.⁴³¹ Colini suggests this wall was associated with the construction of 179 BCE, while Coarelli argues that the Trajanic warehouses are the successor to the Horrea Aemiliana, arguably established by Scipio Aemilianus during his censorship in 142 BCE.⁴³² In sum, the scant archaeological evidence from the sector beneath the Palazzo dell'Anagrafe suggests that the first phase of building activity on top of the reclaimed harbor dates to the second century BCE.

The composite picture provided by the archaeological, literary, and new environmental evidence indicates that sometime in the second half of the second century BCE, the natural harbor in the Forum Boarium was allowed to silt up before the land was filled in and covered with *horrea*, which were subsequently rebuilt under Trajan. Unfortunately, the books of Livy that chronicle the period after 167 BCE were lost, making it difficult to identify precisely the time of the harbor's abandonment or the construction that was erected in this reclaimed area of the Forum Boarium. The evidence of sherds and mortar in borehole FB 49 provide a mid-second century BCE *terminus post quem* for the final accumulation of alluvium in the harbor, a chronology that provides tenuous support for Coarelli's reconstruction of the Horrea Aemiliana in this location. Alternatively, the stratigraphy preserved in FB 49, which is full of *pozzolana* and mortar, may have been deposited in a later period after dredging of the Tiber channel, known to have occurred in the first century CE.⁴³³ Regardless of the precise timeline, the reclamation and

⁴³⁰ Colini and Buzzetti 1986a.

⁴³¹ Colini and Buzzetti 1986a, 191-193.

⁴³² Coarelli 1992, 147-155, 400; 1993; 2007, 309; cf. Harris 1995, 369.

⁴³³ Aldrete 2007, 123-128; Suet. *Aug.* 30; *CIL* 14.85.

new building activity in the Forum Boarium had the resulting effect of shifting the eastern bank of the Tiber River towards the west and more aligned with its modern position,⁴³⁴ forever burying the harbor that until that point had defined the Forum Boarium.

Conclusions: Rome's first conquest

Generations before the Romans began amassing an empire, their first conquest was to tame a disparate and disjointed cluster of hills that rose out of a floodplain. The natural terrain posed many obstacles to urban growth, perhaps explaining why Rome's urban revolution appears to happen some generations later than it does in Etruria, where early settlements were often conveniently positioned on top of high, flat volcanic plateaus. The urban transformation of central Italy has generally been considered a process that occurred gradually over the Late Bronze and Early Iron Ages as small villages or family clusters coalesced into larger nucleated settlements, a process that happened a bit later in Latium than it did in Etruria, which had several proto-cities by the eighth century.⁴³⁵ The growing availability of environmental and archaeological evidence, however, seems to suggest that Rome took an alternative path on the transition from hut settlement to city, one where a period of relative stability on the landscape gives way to considerable and relatively sudden transformation in the Archaic Period.⁴³⁶

After centuries of sedentary growth on the various hills of Rome, it is becoming increasingly apparent that sometime in the late seventh–early sixth century BCE a person or group of people made the conscious decision to commence a series of huge construction projects.

⁴³⁴ cf. Ammerman 2013, 171.

⁴³⁵ For general reference on the synoecism model and theories of state formation processes: Mommsen 1868, 46; Ward Perkins 1961; Barker 1981; Momigliano 1989, 63-82; Torelli 1989; Smith 1995, 1997; Cornell 1995, 92-103; Grandazzi 1997, 143-176; Terrenato and Haggis 2011; Fulminante 2014, 1-34.

⁴³⁶ Rome is not unique for its large-scale urban development, which happens across Latium beginning in the early sixth century (Smith 1997).

Investments in Rome's floodplain occurred alongside other important public works projects in the mid-first millennium BCE, including reclamation of the Forum Romanum valley⁴³⁷ and massive terracing works to support the Temple of Jupiter Optimus Maximus on the Capitoline Hill.⁴³⁸ In totality, the Romans of the Archaic period can be appreciated for their ambitious endeavors to modify their landscape. These undertakings, aimed at reclaiming the lowlands while creating a monumentalized and cohesive cityscape, would have required the mobilization of considerable labor and resources. Landscape modification and continuous management, therefore, were not only prerequisites for urban growth at Rome, but also key stimuli for the development of socio-political structures necessary to confront certain inherent ecological pressures and limitations.

This task of building a city at this strategic bend in the Tiber was rendered even more formidable since the Romans' urban growth prompted secondary, unforeseen environmental consequences. As the Romans deforested and cultivated the river valley, they unwittingly altered the hydrological regime of the region, leading to a measured increase in the frequency and magnitude of floods and sedimentation. This growing environmental stress would prompt adaptive strategies, including activities related to draining, dredging, terracing, as well as the architectural use of stone podia to elevate mudbrick superstructures. By adapting and persevering, the Romans of the fifth through the second centuries could continue to operate in the Forum Boarium valley and capitalize on the opportunities afforded by their harbor. Ultimately, this demonstrable proclivity for landscape modification and management, which defines Rome's early history, would become an enduring characteristic of Roman culture and

⁴³⁷ Ammerman 1990.

⁴³⁸ Tagliamonte 1996; Mura Sommella 2000a; Hopkins 2012b, 2016, 97-125; Potts 2015, 123-124.

urban systems across their later empire,⁴³⁹ as Roman imperialism and engineering spurred urbanization throughout the Mediterranean.

⁴³⁹ Pucci et al. 2011; Purcell 2012.

Conclusion

The growing body of evidence indicates that Rome's urbanization process was extraordinary. If the harbor in the Forum Boarium provides a good measure of the scale of human activity on the local landscape, we can infer two pivotal events in Rome's prehistoric past: the beginnings of sedentary habitation in the second millennium BCE and the inception of a city in the late seventh to the early sixth century BCE. A grandiose vision of sixth century Rome is certainly not a new line of argumentation,⁴⁴⁰ but one that can be reflected upon with new perspective and assurances. Geoarchaeological investigations of the Forum Boarium have revealed or corroborated several ecological details relevant to the region's early development: 1) the origins of sedentary habitation in the vicinity of the harbor date at least to the Late Bronze Age; 2) from the late second and early first millennia BCE, there existed a stable hydrological regime consisting of seasonal, nuisance flooding in the region of the Forum Boarium; 3) the landscape of the early sixth century consisted of several prominent features, including a floodplain terrace that overlooked a river harbor, island, and crossing; 5) the first permanent investment in the floodplain, the early sixth century harbor temple, was built at an elevation safe from most floods; 6) a sudden increase in sedimentation occurred after the early sixth century; and 7) in order to maintain operations around the harbor, the Romans had to dredge excess silt and elevate their harbor sanctuary. This narrative reflects centuries of human-environment

⁴⁴⁰ e.g. Pasquali 1936; Cristofani 1990; Mura Sommella 2000b; cf. Alföldi 1965, 101-175; see also discussion in Chapter 1.

interactions in and around the Forum Boarium valley and provides rich context for understanding Rome's urbanization story.

At its core, Rome was a harbor town. Although the inhabitants of these hills had tapped into regional exchange networks as early as the Bronze Age, the historical, archaeological, and environmental records all confirm that a massive new investment in the late seventh century catapulted them from dispersed hut settlement to a unified city. In order to construct several, new, lavish temples, influenced by diverse (Greek, Etruscan, and Latin) customs,⁴⁴¹ this urban development must have been fueled by wealth and resources funneled through the Forum Boarium. Not coincidentally, Rome's transformation occurred at a time when exchange between Etruria and Greece was growing exponentially and cities were finally starting to take root in Latium.⁴⁴² In fact, just as the inhabitants of Rome erect their first permanent harbor infrastructure in the Forum Boarium, another *emporium* is founded just 90km north from the mouth of the Tiber, at Gravisca (see **fig. 1**). Excavations of Gravisca's harbor and associated sanctuary complex have demonstrated that a Greek (Phocaeen) commercial settlement was established here, in Etruscan territory and directly linked to the settlement at Tarquinia, in the early sixth century. From its foundation, Gravisca was a multicultural *emporium* that facilitated trade between Italy and Greece.⁴⁴³ As Rome's first significant investment in its harbor occurred simultaneously with similar developments at Gravisca, it is worth postulating how much Rome

⁴⁴¹ On the multiethnic architectural and sculptural features of the Archaic harbor temple, see Mertens-Horn 1994, 270); Hopkins (2016, 53-65); Diffendale et al. (2016, 13-14).

⁴⁴² Immense quantities of seventh-sixth century Greek vases have been found in Etruscan tombs, and Etruscan bucchero has been found throughout the eastern Mediterranean. On Etruscan-Greek trade in the seventh-sixth centuries, see Ridgway and Ridgway 1994; Barker and Rasmussen 1998, 117-140; Smith 1999. On early sixth century BCE urbanization in Latium, see Smith (1996, 185-223; 1997; Fulminante 2014, 171-248).

⁴⁴³ Torelli 1977; 1982; 1986; Demetriou 2012, 64-104.

shared with her Tarquinian cousin.⁴⁴⁴ The growth of maritime trade could very well explain why the inhabitants of Rome finally come together to tame their disparate hills and build a cohesive city centered around the convenient harbor in the Forum Boarium. Although the specifics of such a complex cultural process are not found in sedimentary records, they can be evinced from the literary record, although with full acknowledgment of its limitations.

The Augustan historians Livy and Dionysius offer many details on the form and trajectory of Rome's archaic past, but certain themes are particularly relevant for the topic at hand. Although the legends say that Rome had seven kings, only the later three, beginning with L. Tarquinius Priscus, are viewed not simply as archetypal or etiological characters but as potentially historical figures,⁴⁴⁵ in large part because of the well-attested building projects dated to the Archaic period. As the story goes, Priscus was the son of a Tarquinian woman by an especially ambitious Greek trader who fled the Cypselid tyranny in mid-seventh century Corinth:

“A certain Corinthian man, Demaratus by name, from a family of Bacchiadae, desired to engage in commerce and sailed to Italy, bringing his own ship and private cargo. After selling the cargo in the Tyrrhenian cities, which were the most prosperous in Italy at that time, and earning a large profit there, he was no longer desirous of mooring at any other ports, but began to trade upon the same waters continuously, furnishing Greek goods for the Etruscans and ferrying Etruscan goods to the Greeks; he became the master of very great wealth.”⁴⁴⁶

⁴⁴⁴ On the Etruscan *emporium* at Pyrgi, which dates to the late sixth century, see Baglione et al. 2015; Potts 2015, 94-95; Smith 2016.

⁴⁴⁵ Cornell 1995, 119-172; cf. Wiseman 2008, 1-38. Further evidence for the Tarquins' authenticity comes from the François Tomb at Vulci, in which a Cneve Tarchunies Rumach (Gnaeus Tarquinius of Rome) is depicted and named (Forsythe 2005, 103-108).

⁴⁴⁶ Dion. Hal. *Ant. Rom.* 3.46.3: Κορίνθιος τις ἀνὴρ ὄνομα Δημάρατος ἐκ τῆς Βακχιαδῶν συγγενείας ἐμπορεύεσθαι προελόμενος ἐπέπλευσεν εἰς τὴν Ἰταλίαν ὀλκάδα τε οἰκείαν ἀνάγων καὶ φόρτον ἴδιον. ἐξεμπολήσας δὲ τὸν φόρτον ἐν ταῖς Τυρρηνῶν πόλεσιν εὐδαιμονοῦσαις μάλιστα τῶν ἐν Ἰταλίᾳ τότε καὶ μεγάλα κέρδη περιβαλόμενος ἐκείθεν οὐκέτι εἰς ἄλλους ἐβούλετο κατάγεσθαι λιμένας, ἀλλὰ τὴν αὐτὴν εἰργάζετο συνεχῶς θάλατταν Ἑλληνικὸν τε φόρτον εἰς Τυρρηνοὺς κομίζων καὶ Τυρρηνικὸν εἰς τὴν Ἑλλάδα φέρων καὶ γίνεται πάνυ πολλῶν χρημάτων κύριος.

Demaratus, supposedly one of the first Greeks to trade heavily with the Etruscans,⁴⁴⁷ begot a son, Lucumo of Tarquinia. In his first book, Livy recounts the story of Lucumo's enterprising wife, who saw opportunity in migrating to Rome, a place with a reputation for welcoming foreigners:

“While the Etruscans despised Lucumo as having sprung from a foreign exile, [Tanaquil] was not able to endure this indignity and, having forgotten all native affection towards her home city, so long as she might see her husband ennobled, decided to migrate from Tarquinia. Rome seemed to be most suited to her purposes: among a new people, where all nobility happened quickly and stemmed from virtue, there would be a place for a strong and active man; Tatius the Sabine had ruled there, Numa was summoned to the throne by the Cures, and Ancus was sprung from a Sabine mother and was noble only by his ancestor Numa. She easily persuaded the man, as he was desirous of honor and someone for whom Tarquinia was only his country on his mother's side, and thus, carrying all their possessions, they set out for Rome.”⁴⁴⁸

Once in Rome, as the sources say, Lucumo changed his name to suit local customs and readily won over the goodwill of the local inhabitants, a task made easier with his great sums of inherited wealth that he could invest in his new community. For the Romans, this was the era when the main features of the archaic city—Forum, harbor sanctuary, and temple to Jupiter Optimus Maximus—were built. The historical veracity of Demaratus and his role for spurring east-west exchange in the Orientalizing period, however, is debated by scholars, notably David and Francesca Ridgway, who contend that Etruria had access to Corinthian trade networks in southern Italy long before the seventh century, so that undue weight should not be placed on this mythical patriarch of Rome.⁴⁴⁹

⁴⁴⁷ Polybius (6.11.7), drawing on Fabius Pictor, one of the earliest available sources, refers to Demaratus solely as the Corinthian father of the first Tarquin king of Rome (Ridgway and Ridgway 1994, 13).

⁴⁴⁸ Livy 1.34.5-7: *spernentibus Etruscis Lucumonem exule advena ortum, ferre indignitatem non potuit oblitaque ingenitae erga patriam caritatis, dummodo virum honoratum videret, consilium migrandi ab Tarquiniis cepit. Roma est ad id potissimum visa: in novo populo, ubi omnis repentina atque ex virtute nobilitas sit, futurum locum forti ac strenuo viro; regnasse Tatium Sabinum, arcessitum in regnum Numam a Curibus, et Ancum Sabina matre ortum nobilemque una imagine Numae esse. facile persuadet ut cupido honorum et cui Tarquini materna tantum patria esset. sublatis itaque rebus amigrant Romam.*

⁴⁴⁹ Ridgway and Ridgway 1994, 13; cf. Zevi 1995.

Although the figure of Demaratus and his regal son may well be fictive, they nevertheless represent a real, historical connection between the major trading partners of this period. Any number of Greek merchants could have provided the thematic basis for the Demaratus character, and all of the available evidence seems to suggest that Rome of the mid-seventh century was still untamed and fragmented. Since the Etruscans and Greeks were keen to trade, there can be little doubt that Rome's harbor represented a tremendous opportunity and a unique challenge. Was a demonstrable increase in trade between Etruria and Greece the stimulus necessary to coax the inhabitants of Rome to urbanize? Did a foreign king have to lead the way? It is difficult to know for certain, but the composite picture, for all its holes, exposes Rome as a multiethnic *emporium* built by an enterprising group of locals and immigrants, perhaps led by an Etruscan king, in order to control and enrich themselves through Mediterranean exchange networks. The wealth provided from its river harbor enabled Rome to grow and wield tremendous regional power. It seems that the place "destined for the growth of a city" was actually destined for much more.

Tables

Tab. 1: Chronological markers from the Sant'Omobono and Forum Boarium boreholes

Core	Cut	Depth (m)	Elevation (masl)	Date (BCE)	Chronological Marker
SO 22	2	1.66-1.83	5.79 to 5.62	Bronze Age-Iron Age transition	impasto
	2	1.66-1.83	5.79 to 5.62	1225 to 1045 cal BCE	C14 #1: seed (barley)
	2	1.97-1.99	5.48 to 5.46	Bronze Age-Iron Age transition	impasto
	3	2.25-2.47	5.20 to 4.98	Bronze Age-Iron Age transition	impasto
	3	2.25-2.47	5.20 to 4.98	1205 to 1005 cal BCE	C14 #2: seed (wheat)
SO 23	2	1.54-1.69	5.89 to 5.74	Bronze Age-Iron Age transition	impasto
SO 24	4	4.11-4.20	3.28 to 3.19	1115 to 930 cal BCE	C14 #3: seed (wheat)
	4	4.25-4.36	3.14 to 3.03	1220 to 1020 cal BCE	C14 #4: seed (barley)
SO 25	3	2.11	5.32	Bronze Age-Iron Age transition	impasto
SO 26	3	2.34	5.02	Bronze Age-Iron Age transition	impasto
SO 32	5	5.69	7.17	Iron Age (8th century?)	impasto
SO 36	5	4.77-4.87	7.04 to 6.94	1505 to 1415 cal BCE	C14 #5: charcoal
SO 37	3	2.52-2.93	8.15 to 7.74	754 to 411 cal BCE	C14 # 6: dung
FB 38	8	7.30	5.64	mid 2nd c. BCE or later	introduction of mortar
	9	8.60	4.34	post-archaic (4th-1st c. BCE)	top of deposit of Tufo del Palatino & Tufo Lionato
	10	9.25	3.69	late 4th-early 1st c. BCE	Italian black gloss
	12	11.60	1.34	post-archaic (4th-1st c. BCE)	bottom of deposit of Tufo del Palatino & Tufo Lionato
	12	11.62-11.73	1.32 to 1.21	post-archaic (4th-1st c. BCE)	sherd (associated with tuff feature?)
	12	11.72-11.78	1.22 to 1.16	795-545 cal BCE	C14 #7: seeds (polygonum, waterlogged)
	15	14.03-14.43	-1.09 to -1.49	4683-4461 cal BCE	C14 #8: pollen
	15	14.72-14.77	-1.78 to -1.83	4715-4545 cal BCE	C14 #9: wood (above ground beech, waterlogged)
	16	15.20-15.24	-2.26 to -2.30	4934-4727 cal BCE	C14 #10: wood (above ground)
	16	15.73-15.76	-2.79 to -2.82	5215-5025 cal BCE	C14 #11: wood (above ground, waterlogged)
	2	1.18	11.60	late 4th-early 1st c. BCE	Italian black gloss
	4	3.08	9.70	after 7th c. BCE	commonware
	5	4.55	8.23	mid 2nd c. BCE or later	introduction of mortar
FB 39	7	6.70-6.80	6.08 to 5.98	755-405 cal BCE	C14 #12: charcoal
	7	6.80-6.95	5.98 to 5.83	iron age/orientalizing (8th-7th c. BCE)	sherd
	8	7.10	5.68	archaic (6th-5th c. BCE)	sherd
	12	11.18-11.22	1.60 to 1.56	785-520 cal BCE	C14 #13: bone (mammal)
	13	12.36	0.42	archaic (6th-5th c. BCE)	impasto chiaro sabbioso (late 6th c.)?

Tab. 1 cont.

Core	Cut	Depth (m)	Elevation (masl)	Date (BCE)	Chronological Marker
FB 40	15	14.25	-1.47	750-405 cal BCE	C14 #14; bone (tortoise)
	15	14.34	-1.56	iron age/archaic (8th-6th c. BCE)	impasto rosso or commonware?
	5	4.0-4.45	12.68 to 12.23	imperial	five sherds; commonware; creamware
	6	5.02	11.66	republican/imperial	amphora
	6	5.75	10.93	mid 2nd c. BCE or later	introduction of mortar
	7	6.48	10.20	after 7th c. BCE	commonware?
	9	8.42-8.52	8.26 to 8.16	7th-6th c. BCE	Etrusco-Corinthian
	10	9.10-9.0	7.68 to 7.58	1050-910 cal BCE	C14 #15; charcoal
	10	9.82	6.86	orientalizing/archaic (7th-6th c. BCE)	impasto rosso
	10	9.85-10.0	6.83 to 6.68	archaic (6th c. BCE)	sherd
	11	10.50-10.60	6.18 to 6.08	7th-6th c. BCE	sherd
	12	11.20-11.30	5.48 to 5.38	iron age (9th-8th c. BCE)	sherd
	12	11.30-11.40	5.38 to 5.28	iron age (8th c. BCE)	sherd
FB 41	12	11.40	5.28	7th-6th c. BCE	bucchero
	13	12.40-12.50	4.28 to 4.18	8th-7th c. BCE	sherd
	13	12.74	3.94	3703 to 3639 cal BCE	C14 #16; pollen
	3	2.15	16.27	republican/imperial	three sherds
	6	5.40	13.02	mid 2nd c. BCE or later	introduction of mortar
FB 42	6	5.67	12.75	holocene transition	stratigraphy
	8	7.69	10.73	pliestocene	paleolithic flakes
	3	2.90	11.32	mid 2nd c. BCE or later	introduction of mortar
	8	7.92	6.30	holocene transition	stratigraphy
FB 43	4	3.92	9.78	mid 2nd c. BCE or later	introduction of mortar
	5	4.90	8.80	late 4th-early 1st c. BCE	Italian black gloss
	6	5.57-5.75	8.13 to 7.95	archaic (6th-5th c. BCE)	two sherds; commonware or creamware?
	6	5.65-5.85	8.05 to 7.85	6th c. BCE	sherd
	15	14.80-14.85	-1.10 to -1.15	795-550 cal BCE	C14 #17; plant material from sediment sample
	16	15.05	-1.35	archaic (6th-5th c. BCE)	three sherds
FB 44	8	7.80	9.38	republican	two sherds
	10	9.38	7.80	mid 2nd c. BCE or later	introduction of mortar
	10	9.95	7.23	republican (4th-3rd c. BCE)	sherd

Tab. 1 cont.

Core	Cut	Depth (m)	Elevation (masl)	Date (BCE)	Chronological Marker
FB 44	11	10.09-10.26	7.09 to 6.92	republican (3rd c. BCE)	six sherds
	11	10.34	6.84	archaic (7th-6th c. BCE)	sherd
	11	10.55-10.83	6.63 to 6.35	mid 3rd c. BCE	six sherds; black gloss; hellenistic grey ware; petites estampilles
	15	14.37-14.42	2.81 to 2.76	5th-4th c. BCE	sherd
	15	14.67	2.51	iron age/archaic (8th-6th c. BCE)	sherd
FB 45	15	14.70-14.77	2.48 to 2.41	6th-4th c. BCE	sherd; white ingobbio
	16	15.86-15.90	1.32 to 1.28	395-205 cal BCE	C14 #18; wood (above ground, waterlogged)
	6	5.15	12.77	mid 2nd c. BCE or later	introduction of mortar
	6	5.26	12.66	republican/imperial	amphora
	9	8.54	9.38	post-archaic (5th-3rd c. BCE)	commonware
FB 46	10	9.35-9.40	8.57 to 8.52	390-205 cal BCE	C14 #19; wood (above ground, charred)
	13	12.37	5.55	late 4th-early 1st c. BCE	Italian black gloss
	13	12.55	5.85	mid 2nd c. BCE or later	introduction of mortar
	13	12.85	5.55	late 4th-early 1st c. BCE	Italian black gloss
	13	12.84-12.92	5.56 to 5.48	355-120 cal BCE	C14 #20; bone (cattle, worked)
FB 47	15	14.40-14.50	4.0 to 3.90	post-archaic (after the late 4th c. BCE)	sherd
	15	14.67-14.80	3.73 to 3.60	395-210 cal BCE	C14 #21; seed (emmer wheat)
	15	14.80-14.90	3.60 to 3.50	archaic (6th c. BCE)	bucchero and impasto chiaro sabbioso
	15	14.90-14.98	3.50 to 3.42	archaic (late 7th-5th c. BCE)	sherd
	4	3.24-3.31	10.19 to 10.12	after 7th c. BCE	two sherds; commonware; creamware
FB 47	6	5.42	8.01	mid 2nd c. BCE or later	introduction of mortar
	7	6.0	7.43	early 5th c. BCE	top of Tufo del Palatino & Lapis Albanus (cf. ASSO podium)
	7	6.54	6.89	after 7th c. BCE	commonware sherd at boundary between tuff
	9	8.50	4.93	early 5th c. BCE	bottom of Tufo del Palatino & Lapis Albanus (cf. ASSO podium)
	9	8.80-8.90	4.63 to 4.53	1625-1500 cal BCE	C14 #22; plant material from sediment sample
FB 47	10	9.60	3.83	3355-3095 cal BCE	C14 #23; organic sediment
	12	11.65-11.70	1.78 to 1.73	805-765 cal BCE	C14 #24; plant material from sediment sample
	14	13.85	-0.42	iron age (8th c. BCE)	two sherds, impasto?
	14	13.80-14	-0.37 to -0.57	iron age or archaic (8th-6th c. BCE)	sherd
	15	14.10-14.13	-0.67 to -0.70	after 7th c. BCE	impasto rim
	15	14.15-14.25	-0.72 to -0.82	archaic, not earlier	sherd

Tab. 1 cont.

Core	Cut	Depth (m)	Elevation (masl)	Date (BCE)	Chronological Marker
FB 47	17	16.55	-3.12	1900-1745 cal BCE	C14 #25; plant material from sediment sample
	FB 48	1	0.45	imperial	brick with stamp
		6	5.45	mid 2nd c. BCE or later	tile with mortar
	6	5.85	7.64	mid 2nd c. BCE or later	introduction of mortar
	7	6.80-7.0	6.69 to 6.49	385-200 cal BCE	C14 #26; seeds (grape)
	8	7.10	6.39	republican (3rd-2nd c. BCE)	sherd
	8	7.05-7.3	6.44 to 6.19	6th-2nd c. BCE	Attic/black gloss
	8	7.35	6.14	iron age/orientalizing (8th-7th c. BCE)	two sherds
	8	7.65	5.84	archaic/post-archaic (6th-4th c. BCE)	sherd
	9	8.30	5.19	archaic/post-archaic (6th-4th c. BCE)	sherd
	9	8.84	4.65	archaic/post-archaic (6th-4th c. BCE)	sherd; creamware?
	12	11.05	2.44	iron age/archaic (8th-6th c.)	sherd; commonware?
	12	11.86	1.63	390-205 cal BCE	C14 #27; wood (above ground, waterlogged)
	13	12.20	1.29	late 4th-early 1st c. BCE	Italian black gloss
	15	14.08	-0.59	iron age/archaic (8th-6th c. BCE)	commonware or impasto rosso?
	15	14.70-14.71	-1.21	900-800 cal BCE	C14 #28; plant material from sediment sample
	19	18.60	-5.11	2570-2460 cal BCE	C14 #29; plant material from sediment sample
	20	20.0	-6.51	6215-6050 cal BCE	C14 #30; plant material from sediment sample
FB 49	21	21.0	-7.51	6250-6105 cal BCE	C14 #31; plant material from sediment sample
	29	28.40	-14.91	7305-7075 cal BCE	C14 #32; plant material from sediment sample
	37	36.70	-23.21	8545-8305 cal BCE	C14 #33; plant material from sediment sample
	49	48.60	-35.11	11635-11510 cal BCE	C14 #34; charred material from sediment sample
	10	9.87	7.78	republican/imperial (4th c. BCE or later)	sherd
	11	10.0	7.65	archaic (6th c. BCE)	sherd
	12	11.30	6.35	republican (3rd-2nd c. BCE)	two sherds
	14	13.44-13.57	4.21 to 4.08	archaic/republican (6th-2nd c. BCE)	three sherds
	17	16.25-16.50	1.40 to 1.15	republican/imperial (4th c. BCE or later)	four sherds
	19	18.70	-1.05	mid 2nd c. BCE or later	introduction of mortar
	19	18.77	-1.12	7th-6th c. BCE	Etrusco-Corinthian sherd
	19	18.95	-1.30	6th-5th c. BCE	impasto chiaro sabbioso

Tab. 2: Key elevations (masl) from the Sant'Omobono and Forum Boarium boreholes

Core ID	Core Depth (m)	Starting Elevation	Late Republican	Mid-Republican level	Late Archaic level	Early Archaic level	Late Bronze Age level	Ending Elevation
SO 14	5.05	11.76	n/a	n/a	7.48	≤ 7.48	n/a	6.71
SO 15	3.21	11.17	n/a	n/a	n/a	n/a	n/a	7.96
SO 16	5.50	10.20	n/a	n/a	6.52	≤ 6.52	n/a	4.70
SO 17	3.72	9.18	n/a	n/a	≥ 6.53	6.53	n/a	5.46
SO 18	5.25	10.24	n/a	n/a	6.14	≤ 6.14	n/a	4.99
SO 22	3.49	7.45	n/a	n/a	7.45	≤ 7.45	< 3.96	3.96
SO 23	3.23	7.43	n/a	n/a	7.43	≤ 7.43	< 4.20	4.20
SO 24	4.98	7.39	n/a	n/a	7.39	≤ 7.39	3.03	2.41
SO 25	2.49	7.43	n/a	n/a	7.43	≤ 7.43	< 4.94	4.94
SO 26	3.21	7.36	n/a	n/a	7.36	≤ 7.36	< 4.15	4.15
SO 30	6.24	10.76	n/a	8.79	n/a	n/a	n/a	4.52
SO 31	2.33	12.26	n/a	n/a	n/a	n/a	≥ 10.19	9.93
SO 32	6.27	12.86	n/a	n/a	7.42	≤ 7.42	n/a	6.59
SO 33	3.29	11.81	n/a	n/a	n/a	n/a	n/a	8.52
SO 34	4.99	9.59	n/a	n/a	6.38	≤ 6.38	n/a	4.60
SO 35	3.59	10.32	n/a	n/a	n/a	n/a	n/a	6.73
SO 36	5.27	11.81	n/a	n/a	≥ 7.50	≥ 7.50	≥ 7.50	6.54
SO 37	4.11	10.67	n/a	n/a	7.74	n/a	n/a	6.56
FB 38	16.0	12.94	5.64	4.34	n/a	1.16	< 1.16	-3.06
FB 39	15.0	12.78	8.23	7.28	n/a	-1.56	n/a	-2.22
FB 40	15.0	16.68	10.93	7.8	n/a	5.28	< 5.10	1.68
FB 41	15.0	18.42	13.02	≥ 12.75	≥ 12.75	≥ 12.75	≥ 12.75	3.42
FB 42	15.0	14.22	11.32	≥ 6.30	≥ 6.30	≥ 6.30	≥ 6.30	-0.78
FB 43	16.0	13.70	9.78	9.05	n/a	-1.35	n/a	-2.30
FB 44	16.0	17.18	7.78	1.28	n/a	n/a	n/a	1.18
FB 45	16.0	17.92	13.47	5.55	n/a	n/a	n/a	1.92

Tab. 2 cont.

Core ID	Core Depth (m)	Starting Elevation	Late Republican level	Mid-Republican level	Late Archaic level	Early Archaic level	Late Bronze Age level	Ending Elevation
FB 46	15.0	18.40	5.83	3.60	n/a	n/a	n/a	3.4
FB 47	30.0	13.43	8.01	7.43	4.93	-0.82	ca. 3.0	-16.57
FB 48	56.0	13.49	7.64	-0.36	n/a	-0.59	ca. -3.0	-42.51
FB 49	19.0	17.65	-1.05	n/a	n/a	-1.30	n/a	-1.35

Tab. 3: Radiocarbon results from the Sant’Omobono and Forum Boarium boreholes

C14 Sample	Core ID	Elevation (masl)	Sample Material	Laboratory Code	Radiocarbon age BP	Calibrated age BCE (1σ)	Calibrated age BCE (2σ)
1	SO 22-2	5.79 to 5.62	seed (hulled barley)	Beta 393853	2940 +/- 30	1210 to 1110	1225 to 1045
2	SO 22-3	5.20 to 4.98	seed (emmer wheat)	Beta 393850	2900 +/- 30	1120 to 1020	1205 to 1005
3	SO 24-4	3.28 to 3.19	seed (wheat)	Beta 393852	2860 +/- 30	1050 to 1000	1115 to 930
4	SO 24-4	3.14 to 3.03	seed (hulled barley)	Beta 393851	2930 +/- 30	1205 to 1055	1220 to 1020
5	SO 36-5	7.04 to 6.94	charcoal	Beta 393854	3190 +/- 30	1500 to 1430	1505 to 1415
6	SO 37-3	8.15 to 7.74	dung	GrA 64627	2450 +/- 30	746 to 431	754 to 411
7	FB 38-12	1.22 to 1.16	seeds (polygonum, waterlogged)	Beta 449392	2530 +/- 30	785 to 595	795 to 545
8	FB 38-15	-1.09 to -1.49	pollen	DSH 7887	5716 +/- 42	4610 to 4494	4683 to 4461
9	FB 38-15	-1.78 to -1.83	wood (above ground beech, waterlogged)	Beta 449393	5790 +/- 30	4700 to 4605	4715 to 4545
10	FB 38-16	-2.26 to -2.30	wood (above ground)	GrA 66073	5950 +/- 40	4900 to 4780	4934 to 4727
11	FB 38-16	-2.79 to -2.82	wood (above ground, waterlogged)	Beta 424137	6170 +/- 30	5210 to 5055	5215 to 5025
12	FB 39-7	6.08 to 5.98	charcoal	Beta 431184	2440 +/- 30	735 to 415	755 to 405
13	FB 39-12	1.60 to 1.56	bone (mammal)	Beta 449394	2500 +/- 30	770 to 545	785 to 520
14	FB 39-15	-1.47	bone (tortoise)	Beta 424138	2430 +/- 30	730 to 410	750 to 405
15	FB 40-10	7.68 to 7.58	charcoal	Beta 422662	2830 +/- 30	1015 to 930	1050 to 910
16	FB 40-13	3.94	pollen	DSH 7836	4879 +/- 28	3694 to 3642	3703 to 3639
17	FB 43-15	-1.10 to -1.15	plant material from sediment sample	Beta 424139	2540 +/- 30	790 to 760	795 to 550
18	FB 44-16	1.32 to 1.28	wood (above ground, waterlogged)	Beta 431188	2250 +/- 30	380 to 230	395 to 205
19	FB 45-10	8.57 to 8.52	wood (above ground, charred)	Beta 431187	2240 +/- 30	375 to 210	390 to 205
20	FB 46-13	5.56 to 5.48	bone (cattle)	Beta 449396	2170 +/- 30	350 to 180	355 to 120
21	FB 46-15	3.73 to 3.60	seed (emmer wheat)	Beta 431185	2270 +/- 30	390 to 360	395 to 210
22	FB 47-9	4.63 to 4.53	plant material from sediment sample	Beta 422664	3280 +/- 30	1610 to 1505	1625 to 1500
23	FB 47-10	3.83	organic sediment	Beta 430834	4510 +/- 30	3345 to 3105	3355 to 3095
24	FB 47-12	1.78 to 1.73	plant material from sediment sample	Beta 422665	2580 +/- 30	800 to 780	805 to 765
25	FB 47-17	-3.12	plant material from sediment sample	Beta 422666	3500 +/- 30	1885 to 1765	1900 to 1745
26	FB 48-7	6.69 to 6.49	seeds (grape)	Beta 431186	2230 +/- 30	370 to 210	385 to 200

Tab. 3 cont.

C14 Sample	Core ID	Elevation (masl)	Sample Material	Laboratory Code	Radiocarbon age BP	Calibrated age BCE (1 σ)	Calibrated age BCE (2 σ)
27	FB 48-12	1.63	wood (above ground, waterlogged)	Beta 449395	2240 +/- 30	375 to 210	390-205
28	FB 48-15	-1.21	plant material from sediment sample	Beta 424140	2690 +/- 30	840 to 810	900 to 800
29	FB 48-19	-5.11	plant material from sediment sample	Beta 430836	3980 +/- 30	2565 to 2470	2570 to 2460
30	FB 48-20	-6.51	plant material from sediment sample	Beta 422668	7250 +/- 30	6200 to 6065	6215 to 6050
31	FB 48-21	-7.51	plant material from sediment sample	Beta 422669	7350 +/- 30	6235 to 6215	6250 to 6105
32	FB 48-29	-14.91	plant material from sediment sample	Beta 430835	8180 +/- 30	7185 to 7080	7305 to 7075
33	FB 48-37	-23.21	plant material from sediment sample	Beta 422670	9210 +/- 30	8465 to 8330	8545 to 8305
34	FB 48-49	-35.11	charred material from sediment sample	Beta 425692	11720 +/- 40	11615 to 11530	11635 to 11510

Figures

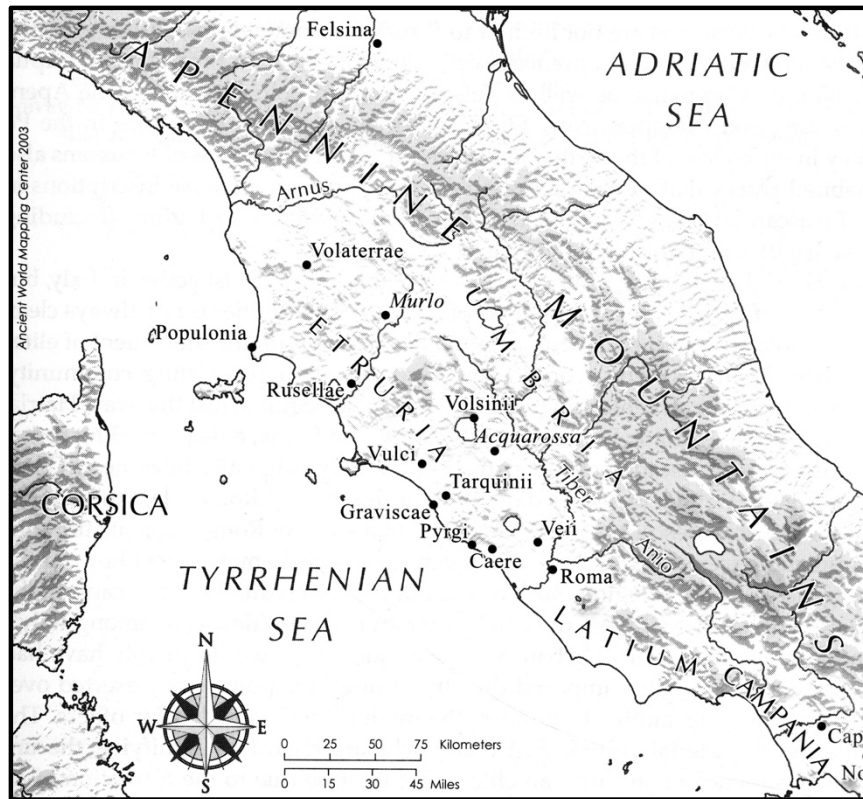


Fig. 1: Map of central Italy

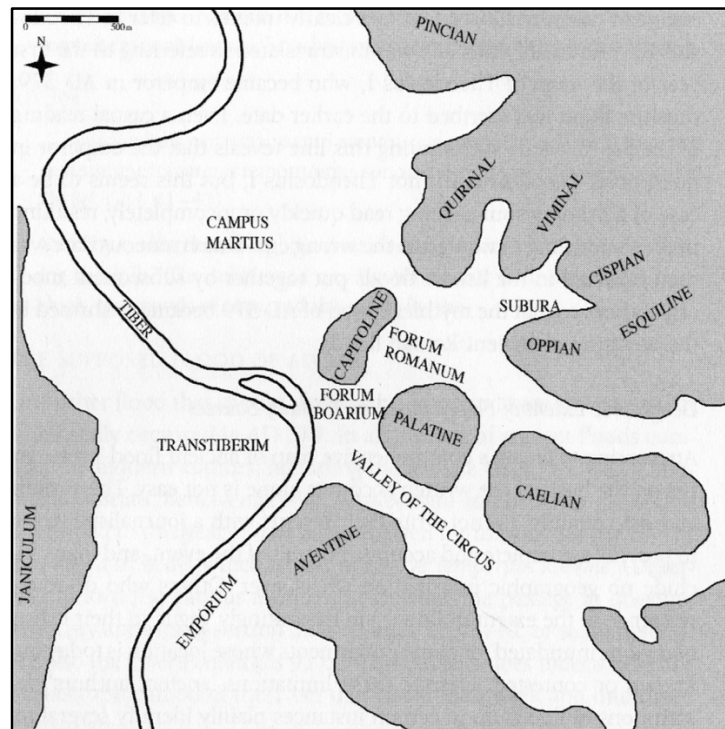


Fig. 2: Map of Rome with key hills and valleys labeled (Aldrete 2007, fig. 1.2)

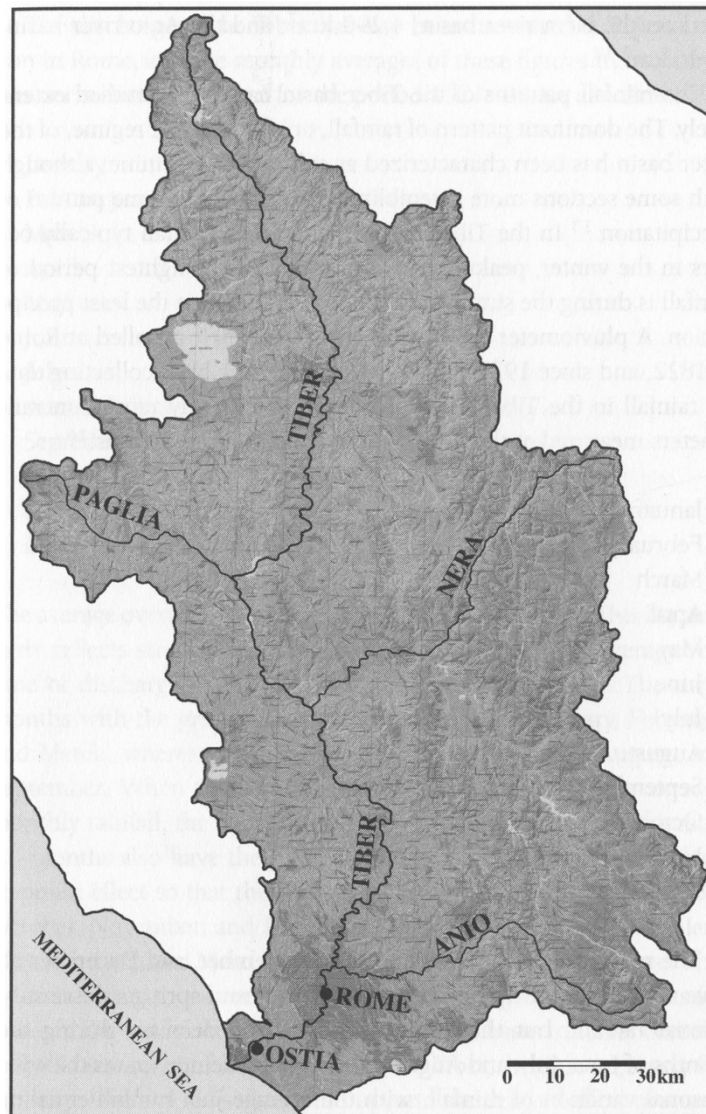


Fig. 3: Map of the Tiber River's catchment basin (Aldrete 2007, fig. 2.4)

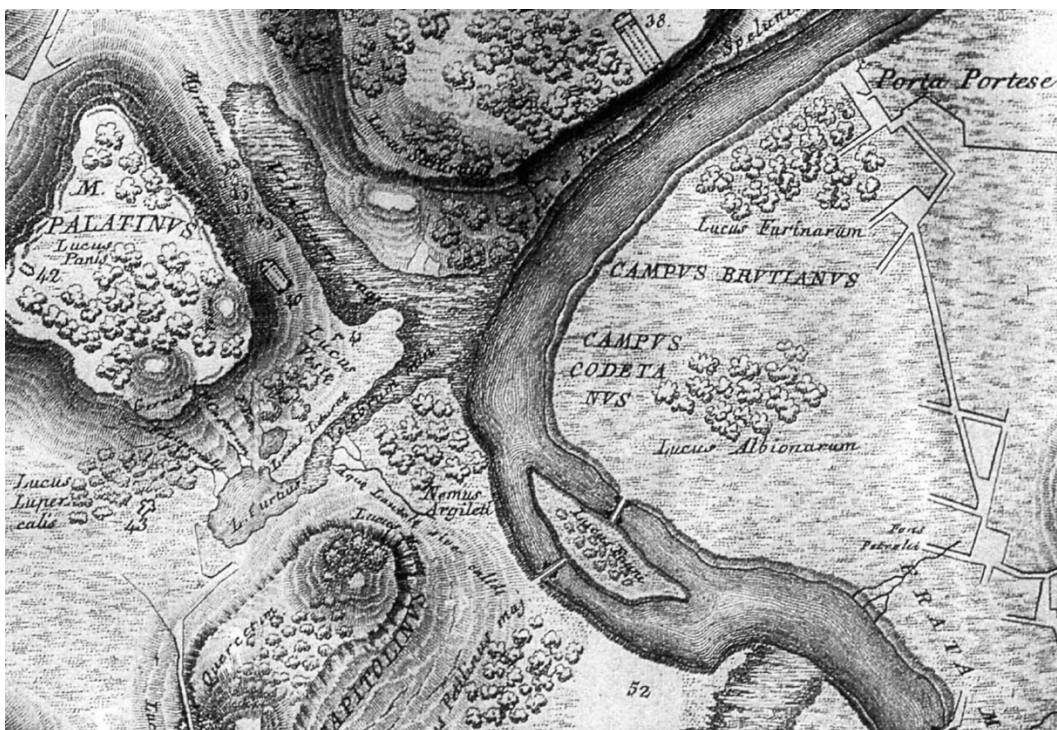


Fig. 4: Sketch of Rome's natural landscape drawn by Giovanni Battista Brocchi in 1820 ("La carta fisica del suolo di Roma")

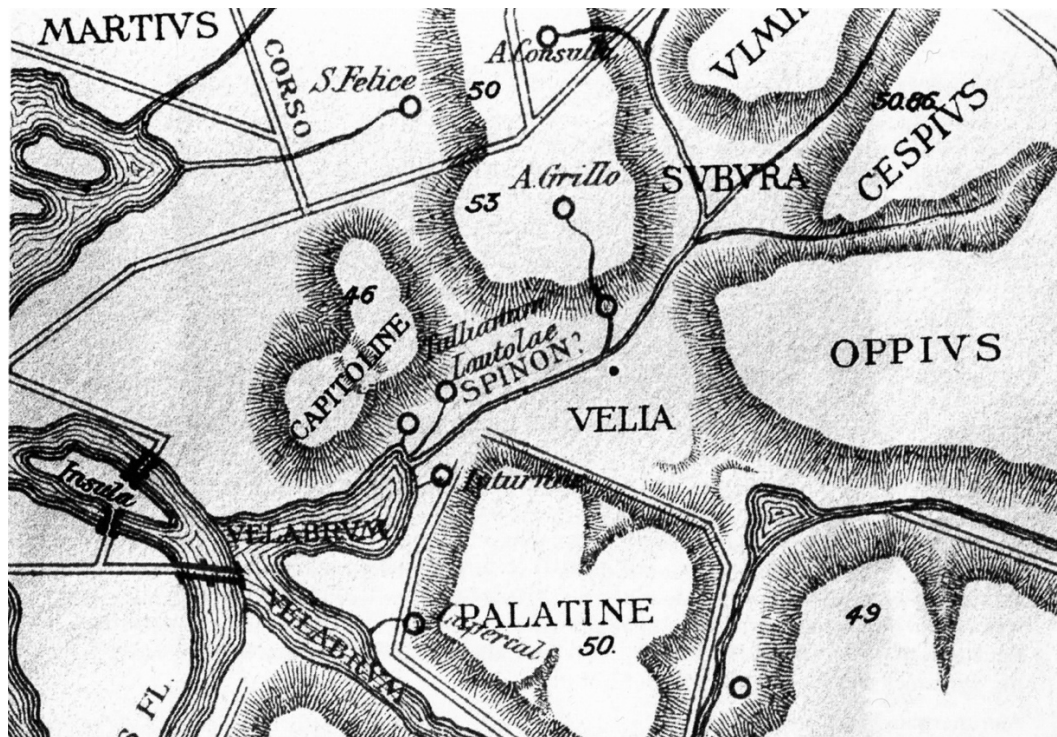


Fig. 5: Sketch of Rome's natural landscape drawn by Rodolfo Lanciani in 1897 (Lanciani 1897, fig. 1)

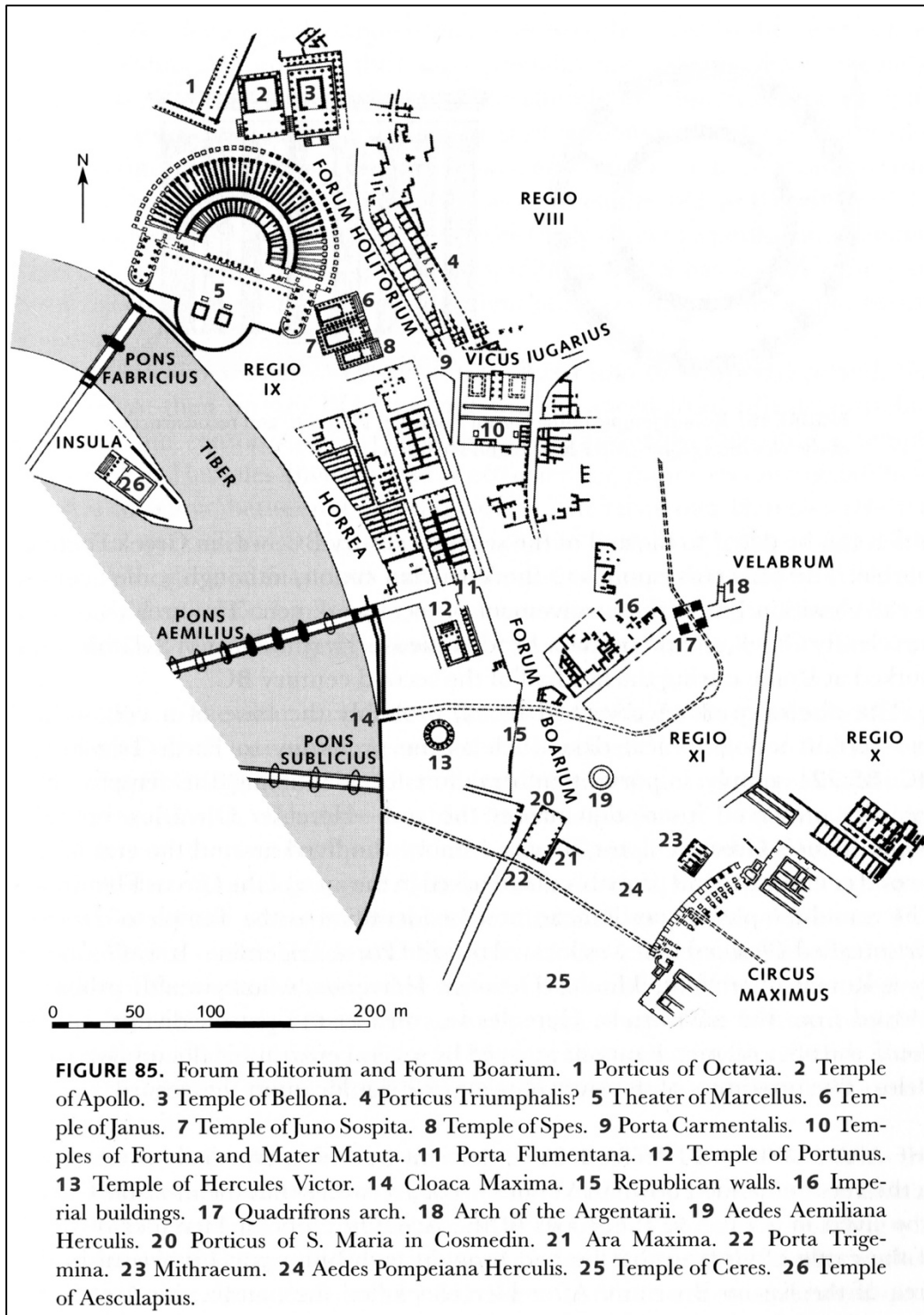


Fig. 6: Plan of the Forum Boarium valley in the Imperial era (Coarelli 2007, fig. 85)



Fig. 7: Photo of the Palazzo dell'Anagrafe and Rome's modern river embankments, viewed looking east from the Tiber Island (Lindvall forthcoming, fig. 2)

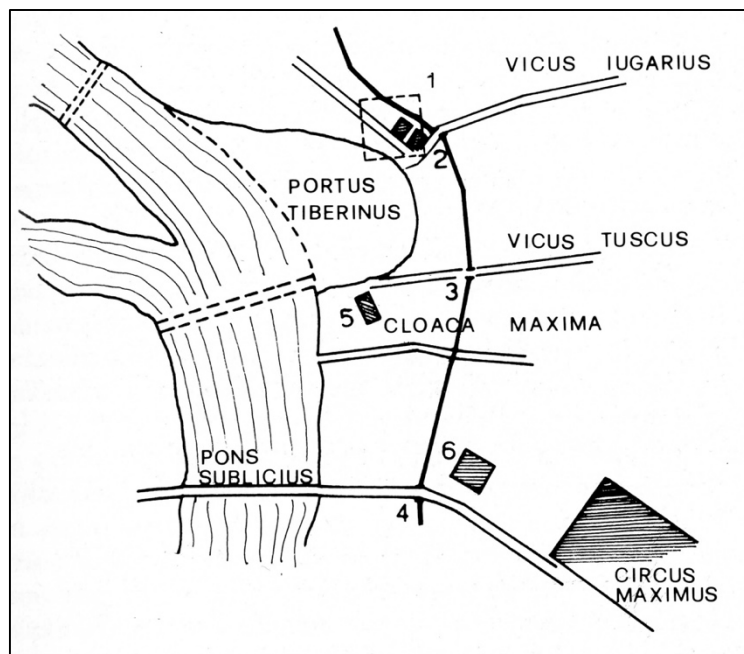


Fig. 8: Sketch plan of the Forum Boarium by Filippo Coarelli in 1988 (Coarelli 1992, 241)

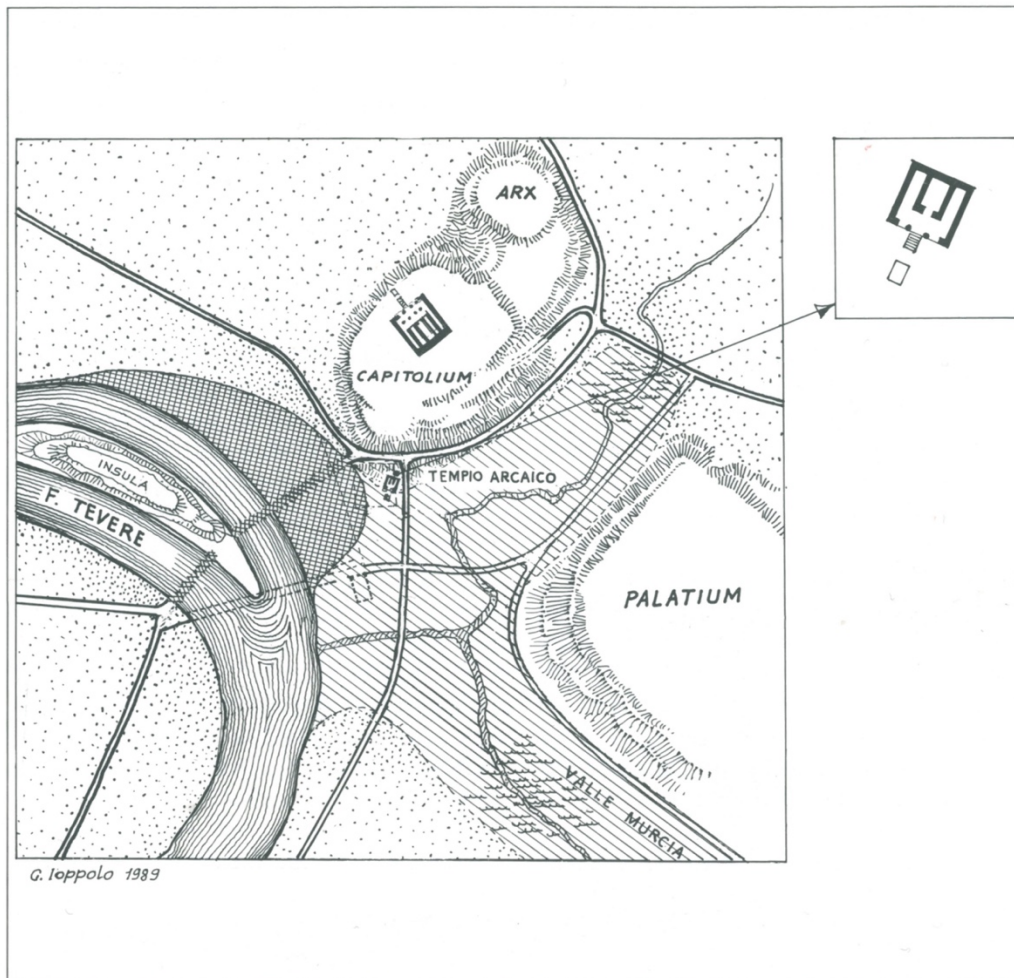


Fig. 9: Sketch map of the Archaic Portus Tiberinus by Giovanni Ioppolo in 1989 (*Il Viver Quotidiano in Roma Arcaica: Materiali dagli scavi del Tempio Arcaico nell'area sacra di S. Omobono*, fig. 3)



Fig. 10: Sketch visualization of the Archaic Portus Tiberinus by Giovanni Ioppolo in 1989 (*Il Viver Quotidiano in Roma Arcaica: Materiali dagli scavi del Tempio Arcaico nell'area sacra di S. Omobono*, tav. 1)



Fig. 11: Detail view of the Forum Boarium district from the model of Archaic Rome at the Museo della Civiltà Romana, built by Lorenzo Quilici in 1990



Fig. 12: Photo of the Round Temple in the Forum Boarium during a flood in December 1900

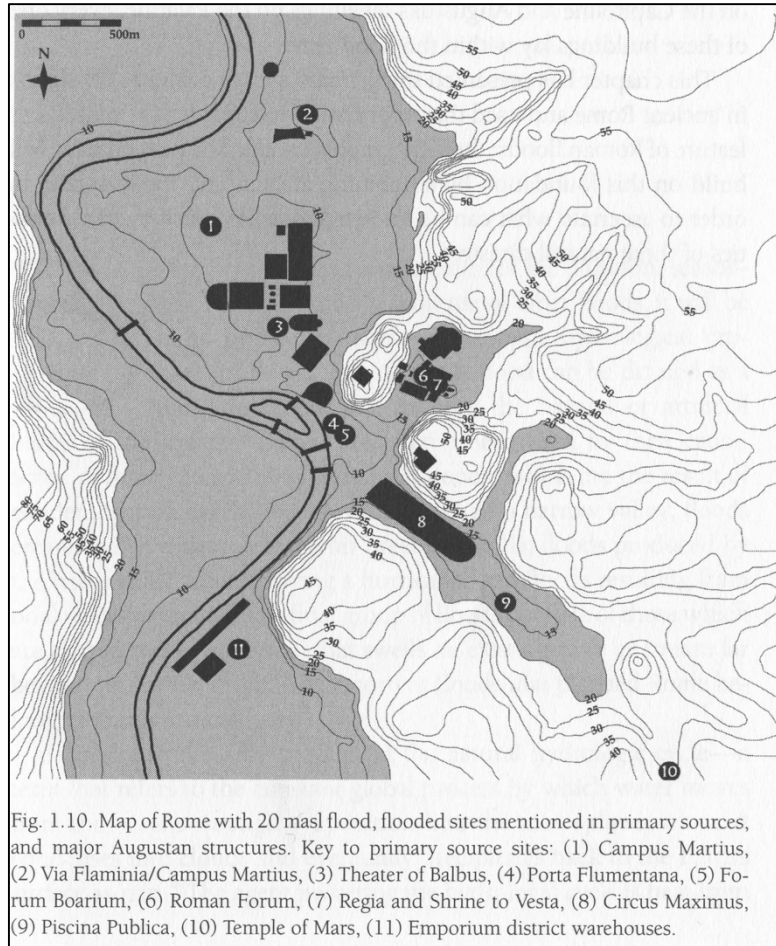


Fig. 13: Map of Augustan Rome during a major flood to an elevation of 20masl (Aldrete 2007, fig. 1.10)

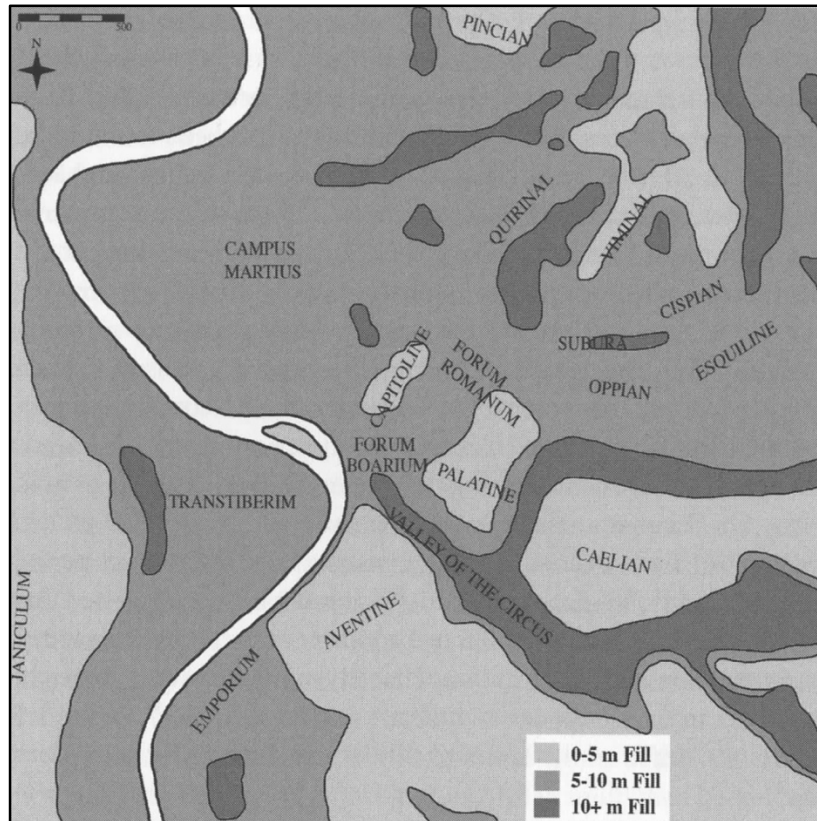


Fig. 14: Map showing the depth of fill in Rome's valleys (Aldrete 2007, fig. 1.5)

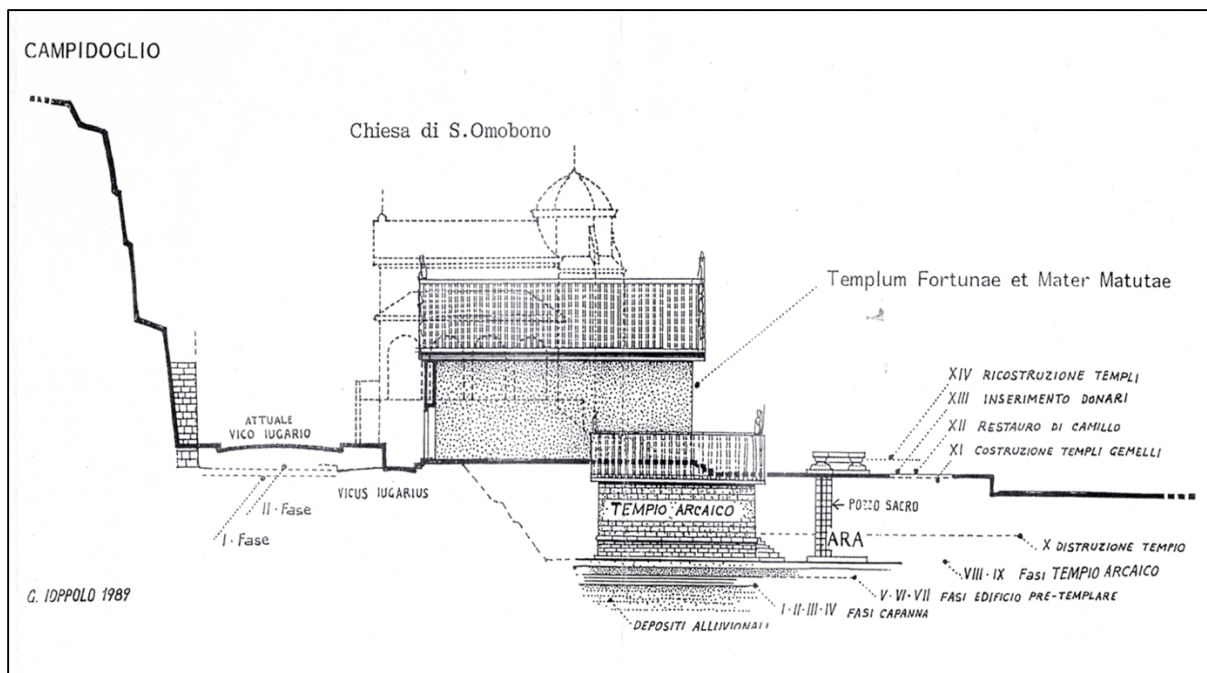


Fig. 15: Cross section of the building phases at the Sant'Omobono Sanctuary (G. Ioppolo)

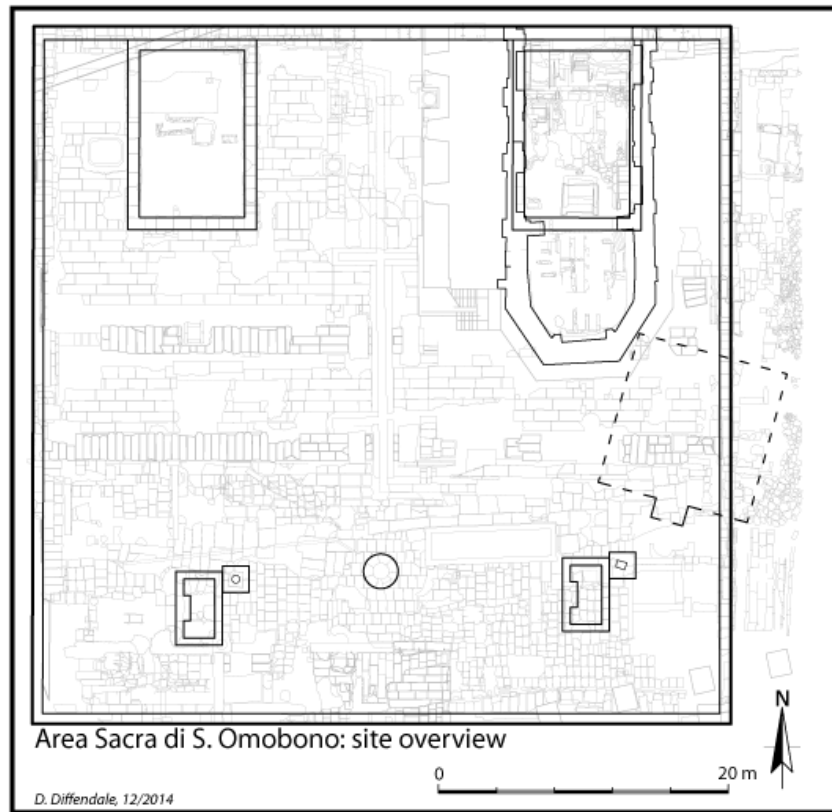


Fig. 16: Plan of the Sant'Omobono Sanctuary showing the outline of the Early Archaic podium buried beneath the Late Archaic platform that supports the twin temples of Fortuna and Mater Matuta along with their associated altars (D. Diffendale)

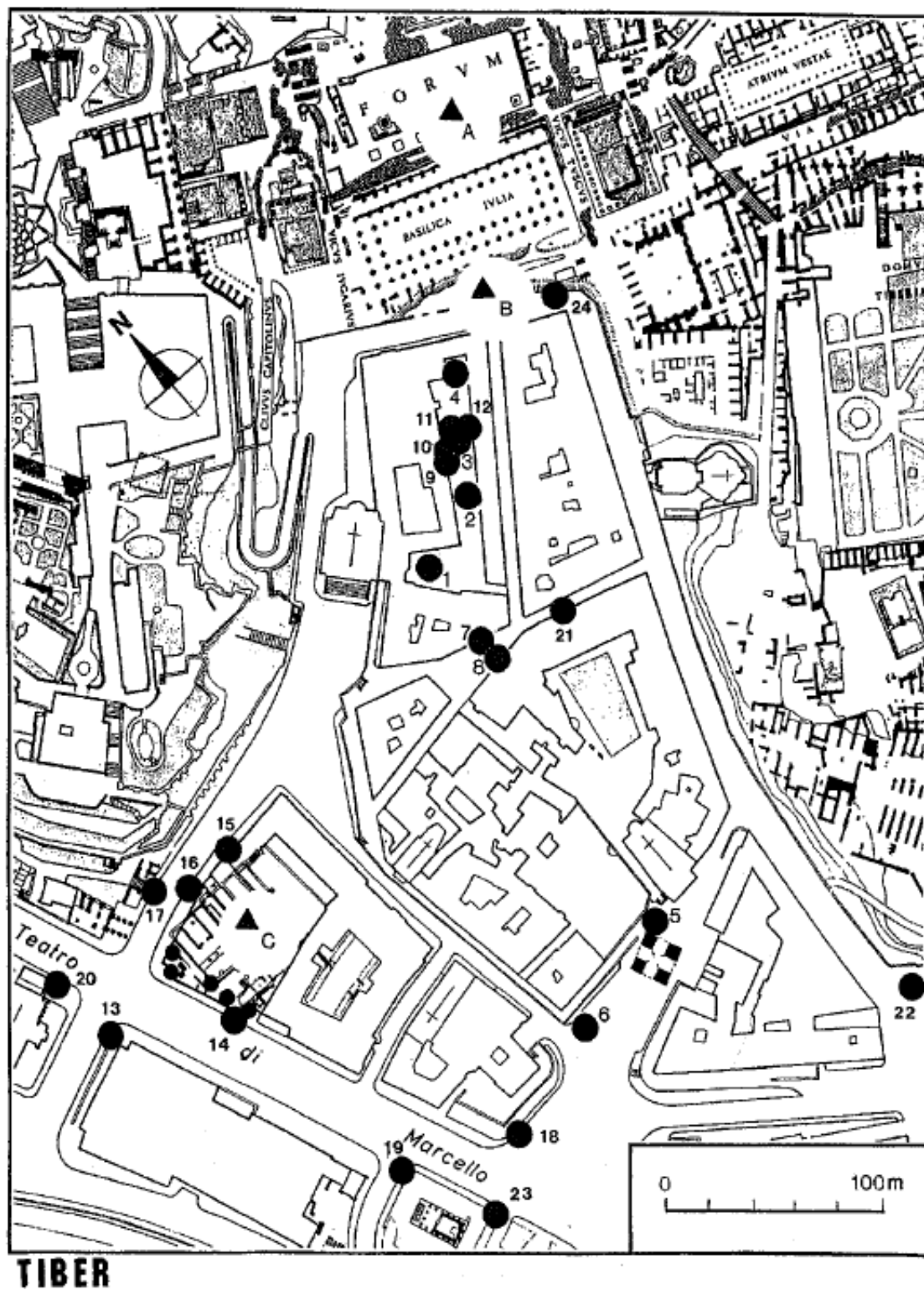


Fig. 17: Plan of the Velabrum valley showing the location of 24 cores produced by Albert Ammerman in the 1990s (Ammerman et al. 2008, fig. 1)



Fig. 18: Photo of the archaeological site of Sant'Omobono, looking north (P. Brocato)

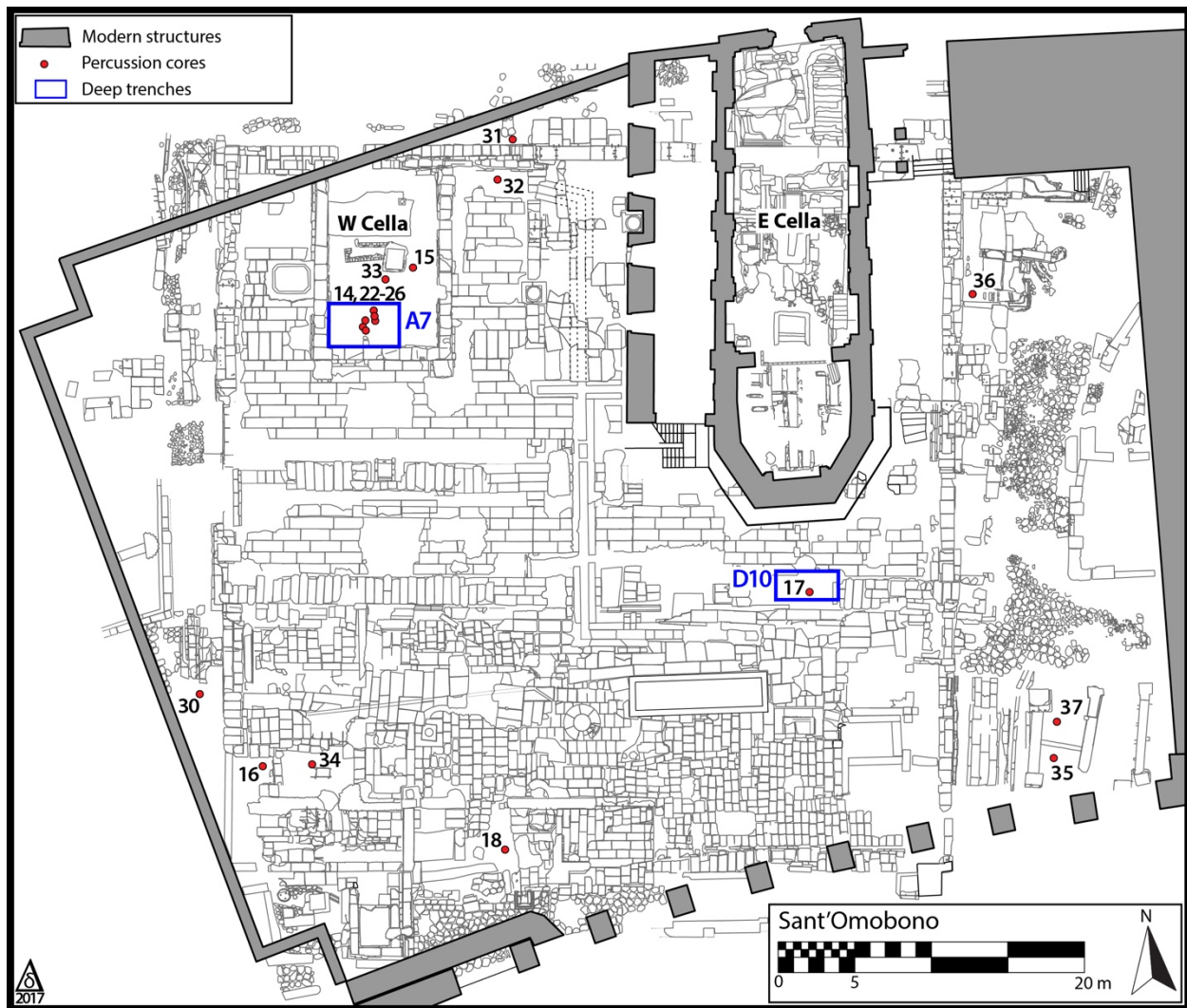


Fig. 19: Plan of the Sant'Omobono Sanctuary showing the location of deep investigations in 2013-2014, including trenches A7 and D10 and percussion cores SO 14-37 (D. Diffendale)

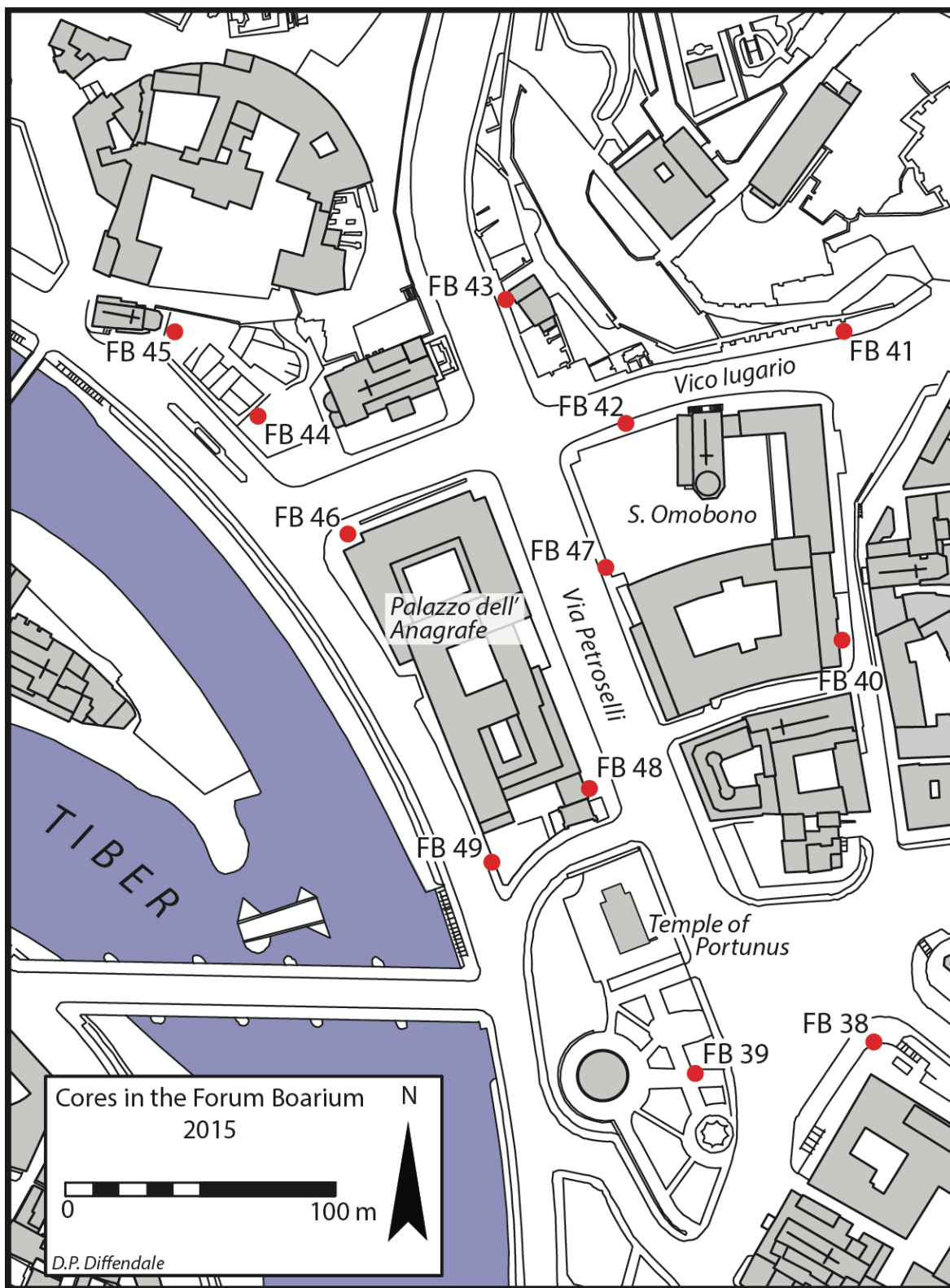


Fig. 20: Plan of the Forum Boarium showing the locations of the Sant'Omobono Sanctuary and mechanized cores FB 38-49 produced in 2015 (D. Diffendale)



Fig. 21: View inside deep trench A7 during excavation in 2014 (D. Diffendale)



Fig. 22: View of the Archaic podium during excavation in deep trench D10 in 2013



Fig. 23: Composite photo of the interior wall of the Late Archaic platform following excavations of deep trench A7 in 2014 (D. Diffendale)



Fig. 24: View of percussion coring underway inside the western cella at Sant’Omobono in 2013

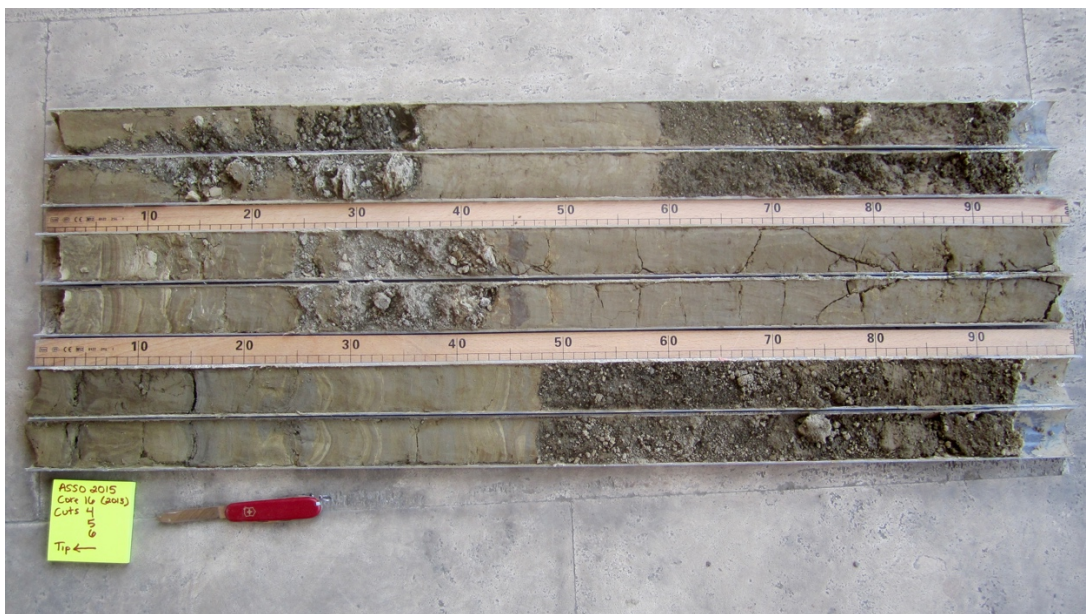


Fig. 25: View of three sections from a single sediment borehole produced during the percussion coring survey of the Sant’Omobono Sanctuary



Fig. 26: View of the drilling machinery during work on core FB 39 behind the Temple of Portunus in 2015

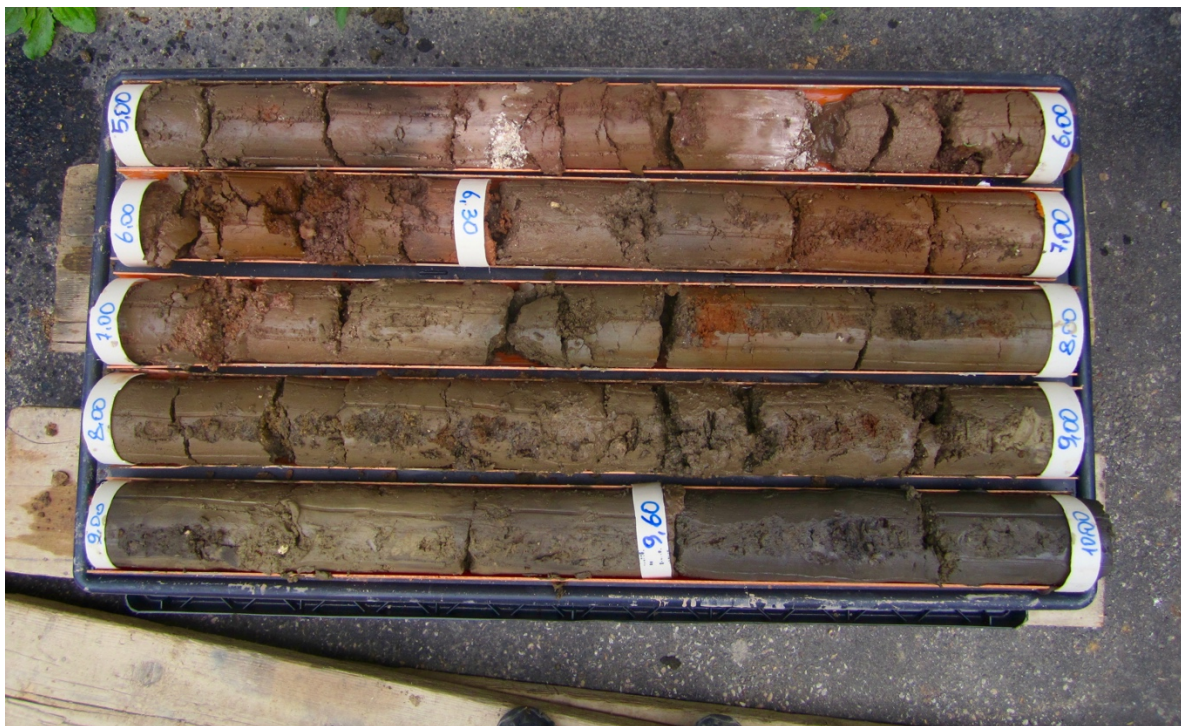


Fig. 27: View of five sections from a single sediment borehole produced during the mechanized coring survey of the Forum Boarium in 2015



Fig. 28: Photo on the balcony of the Sant'Omobono church, showing a portion of the mechanized boreholes produced in 2015

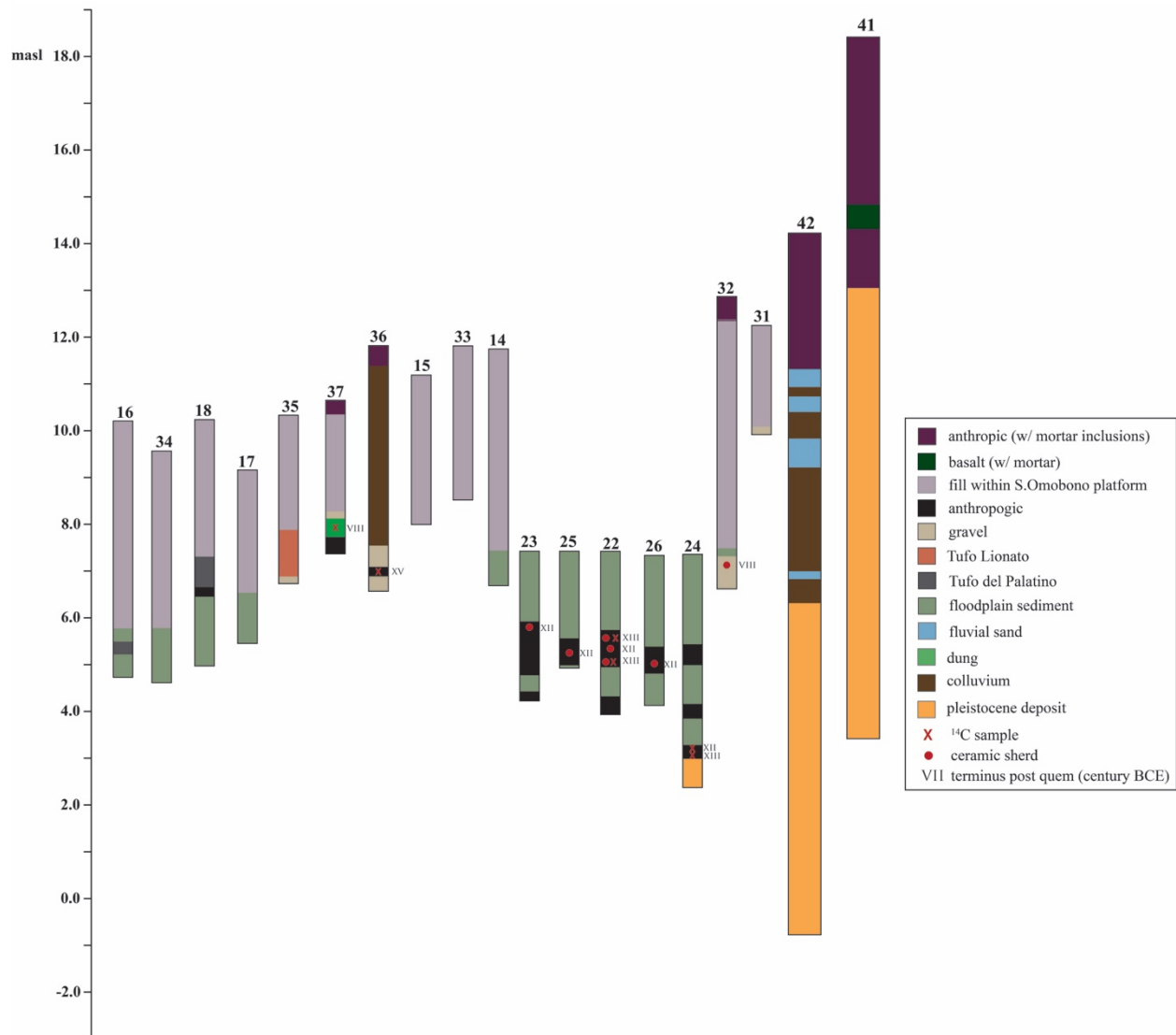


Fig. 29: Profile drawings of boreholes that exposed stratigraphy associated with the Capitoline Hill and the floodplain beneath the Sant’Omobono Sanctuary, including FB 41-42, SO 14-18, SO 22-26, SO 31-37

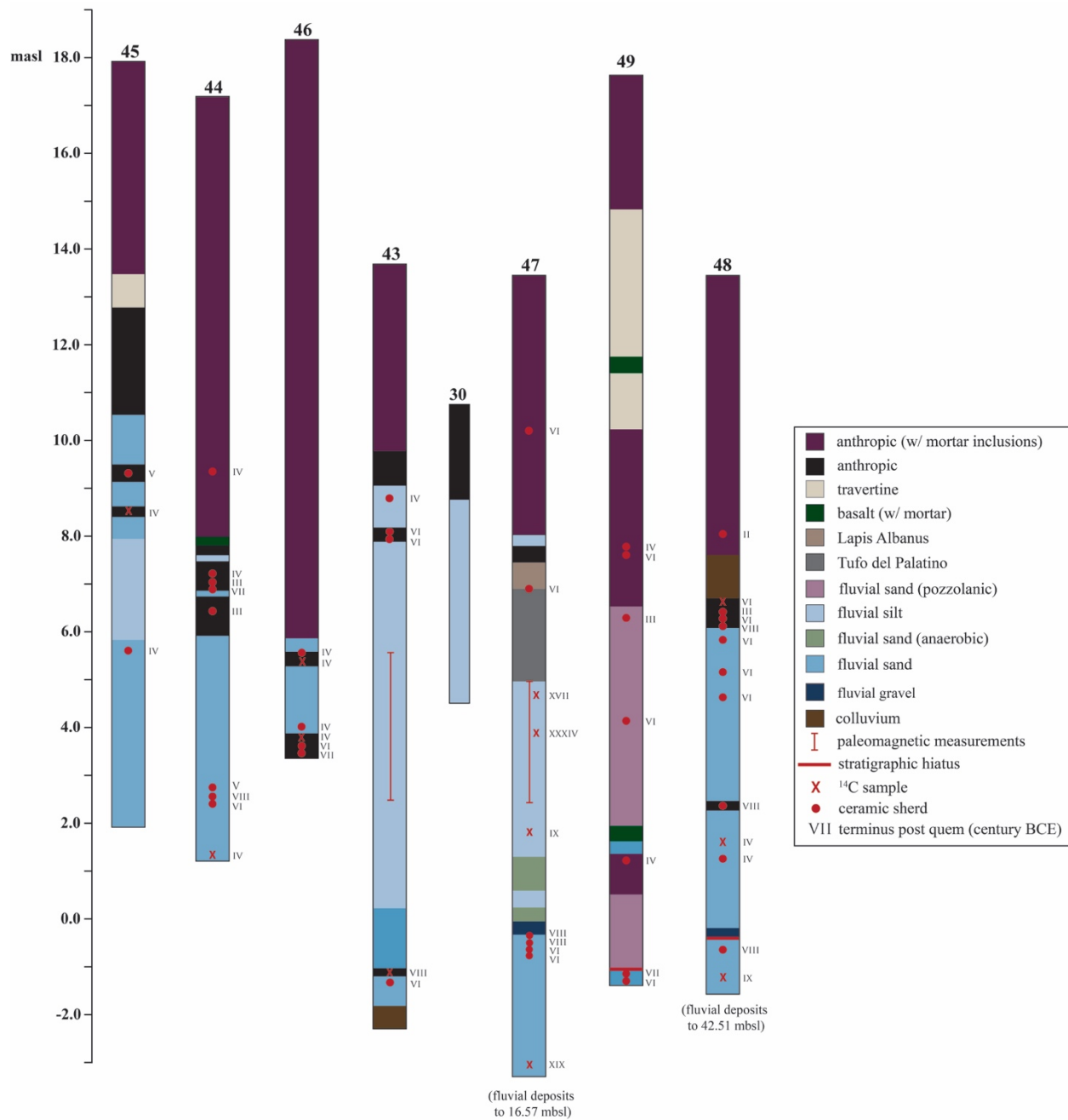


Fig. 30: Profile drawings of boreholes that exposed stratigraphy associated with the Tiber's river channel, including FB 43-49, SO 30

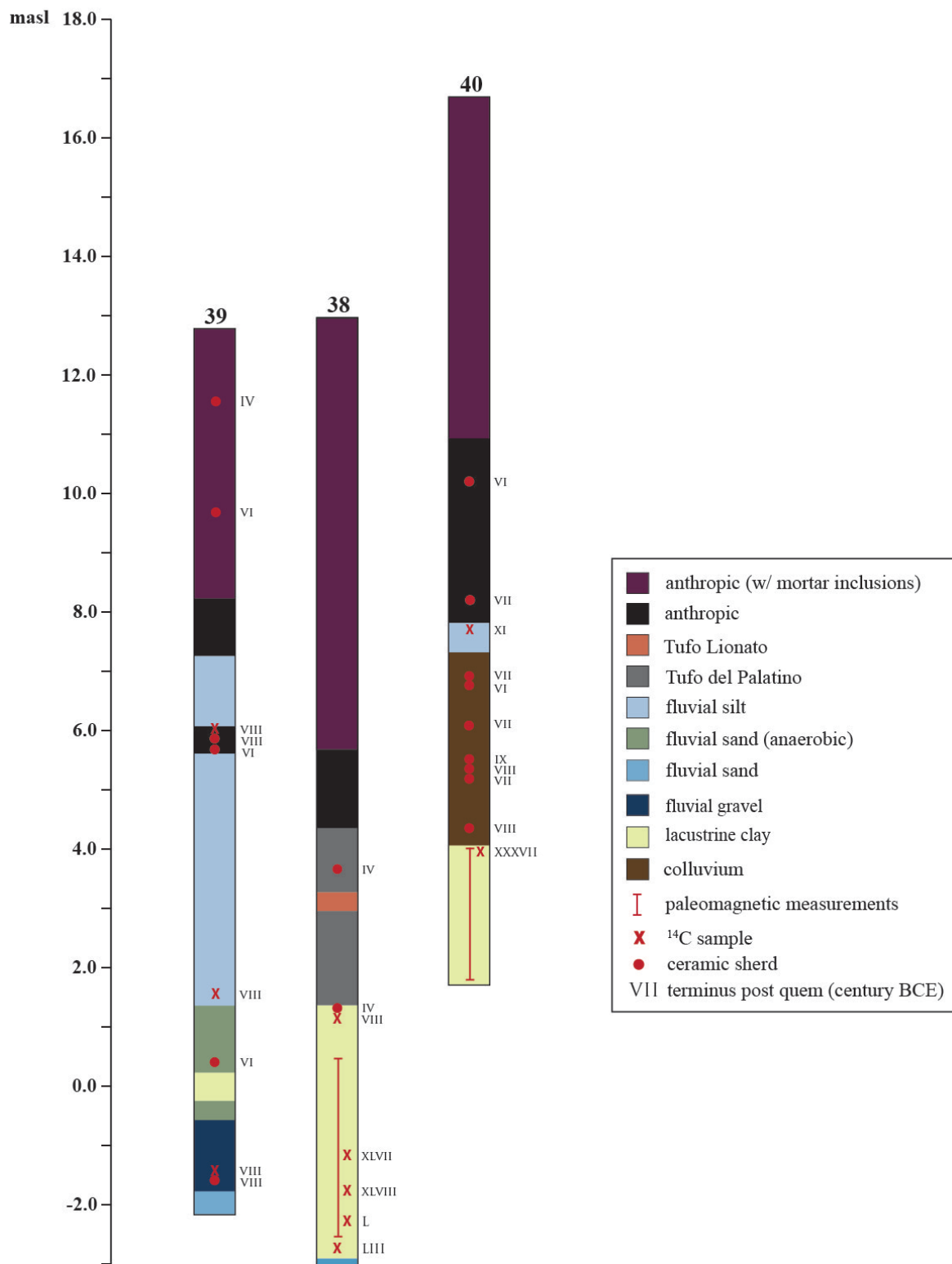


Fig. 31: Profile drawings of boreholes that exposed stratigraphy associated with the Velabrum valley, including FB 38-40

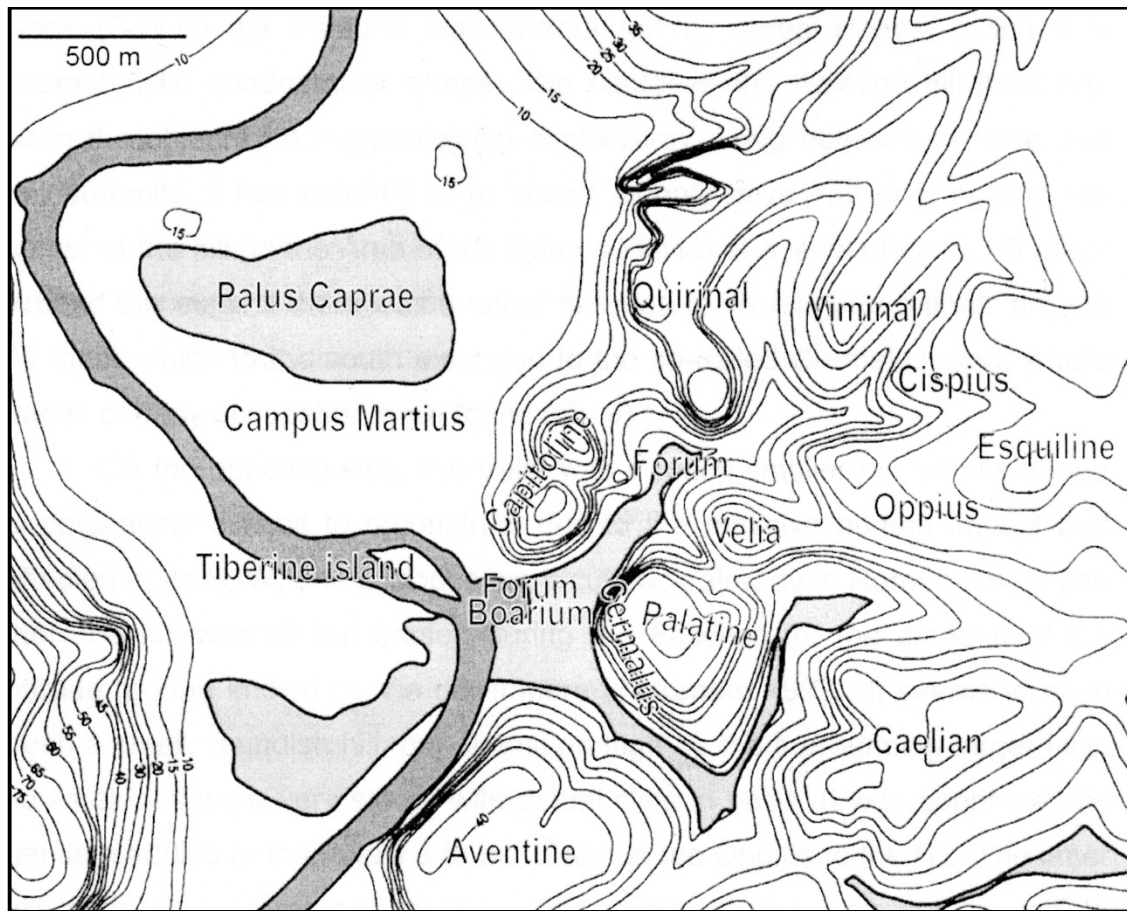


Fig. 32: Contour map of Rome with the main topographical features marked and the lowland areas susceptible to flooding shown in light grey (Motta 2011, fig. 14)

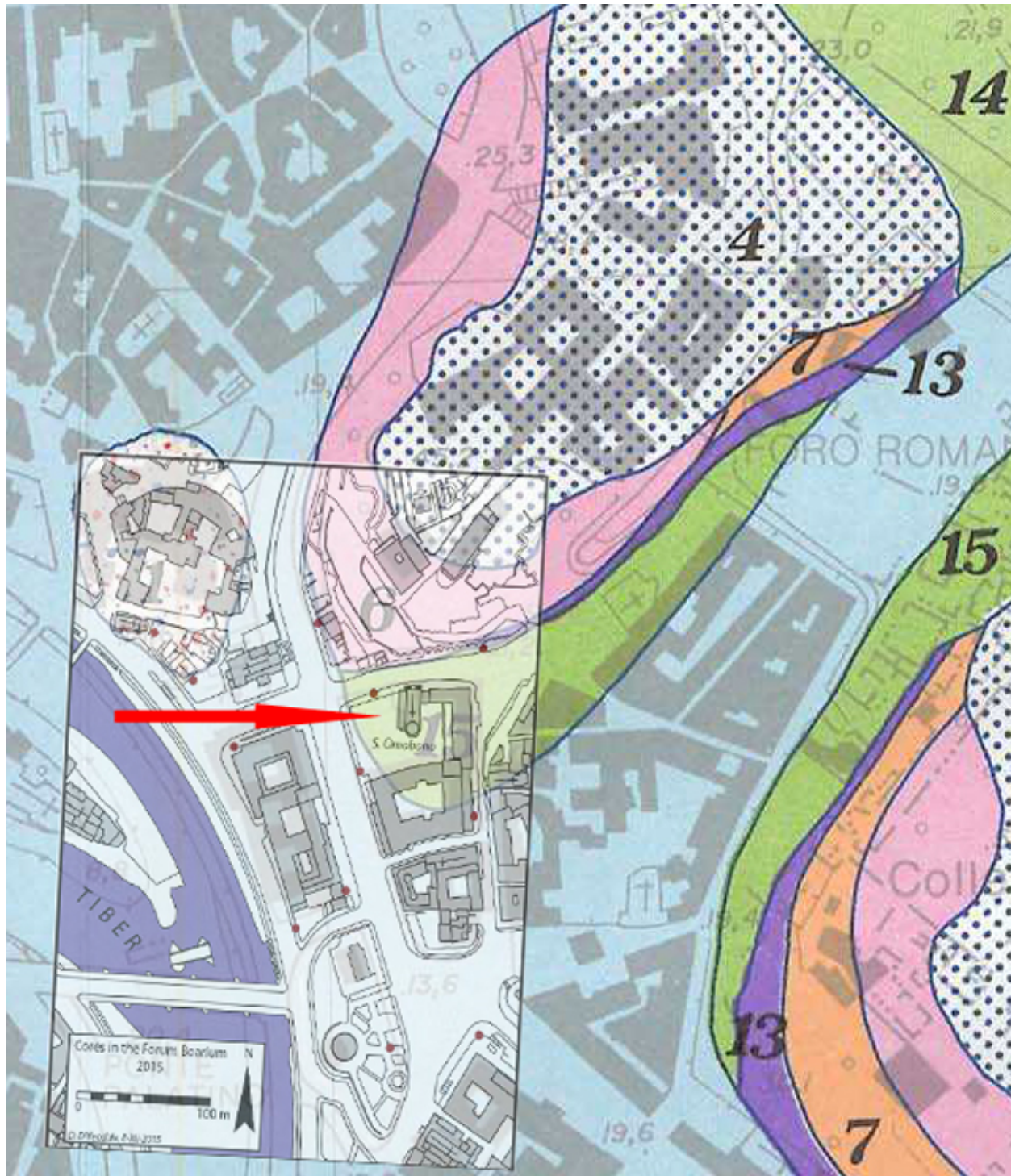


Fig. 35: Superposition of a plan of the Forum Boarium on the “Carta Geologica del Centro Storico di Roma” (Funiciello et al. 1995), showing deposits of volcanic tuff (pink: Tufo Lionato; purple: Tufo del Palatino) that cover fluvial deposits of the Paleo-Tiber (green)

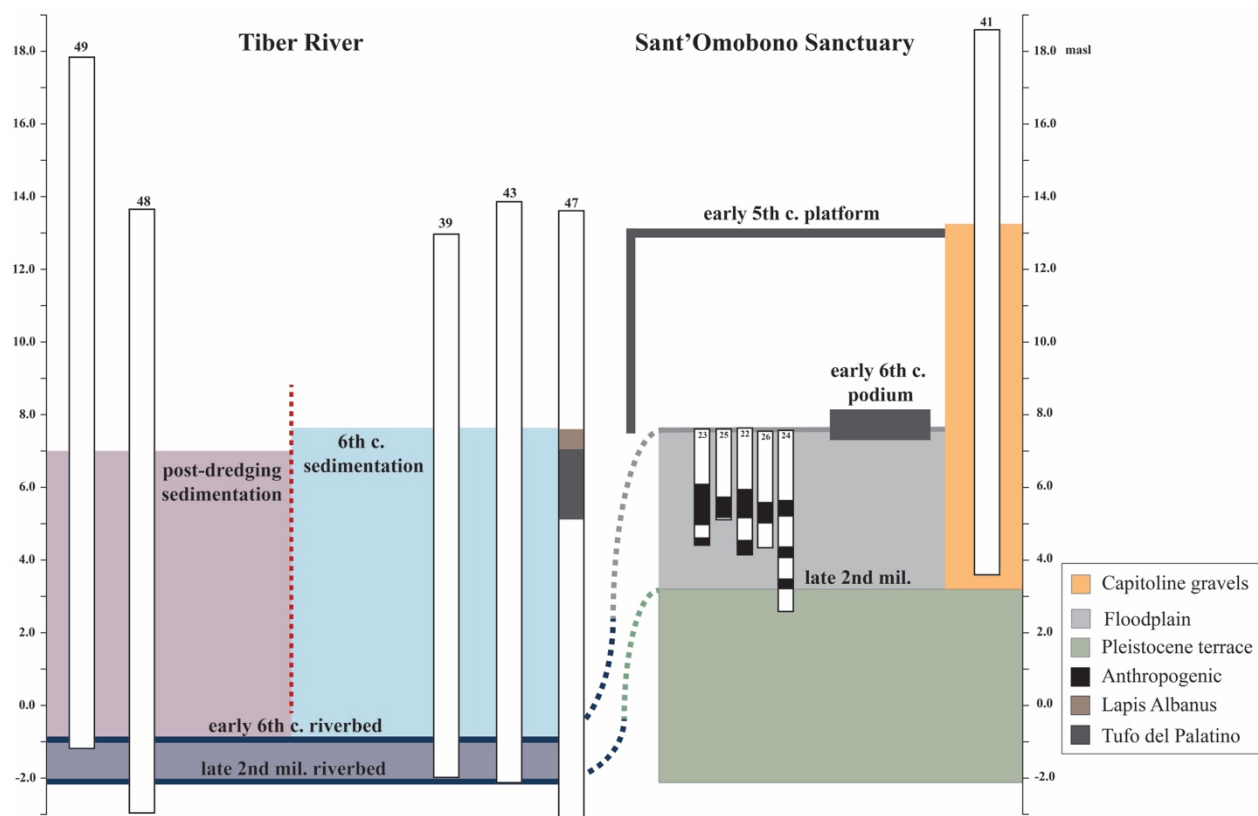


Fig. 36: Schematic diagram of the stratigraphy in the Forum Boarium

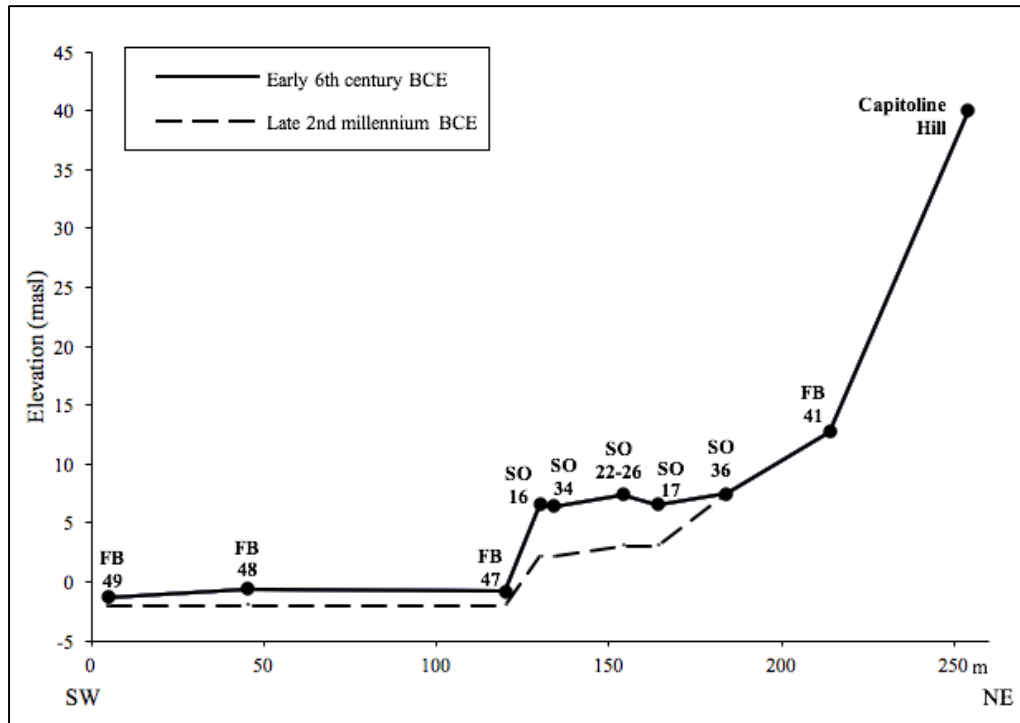


Fig. 37: Southwest-northeast profile of the natural relief of the Forum Boarium valley from the Tiber's channel to the Capitoline Hill

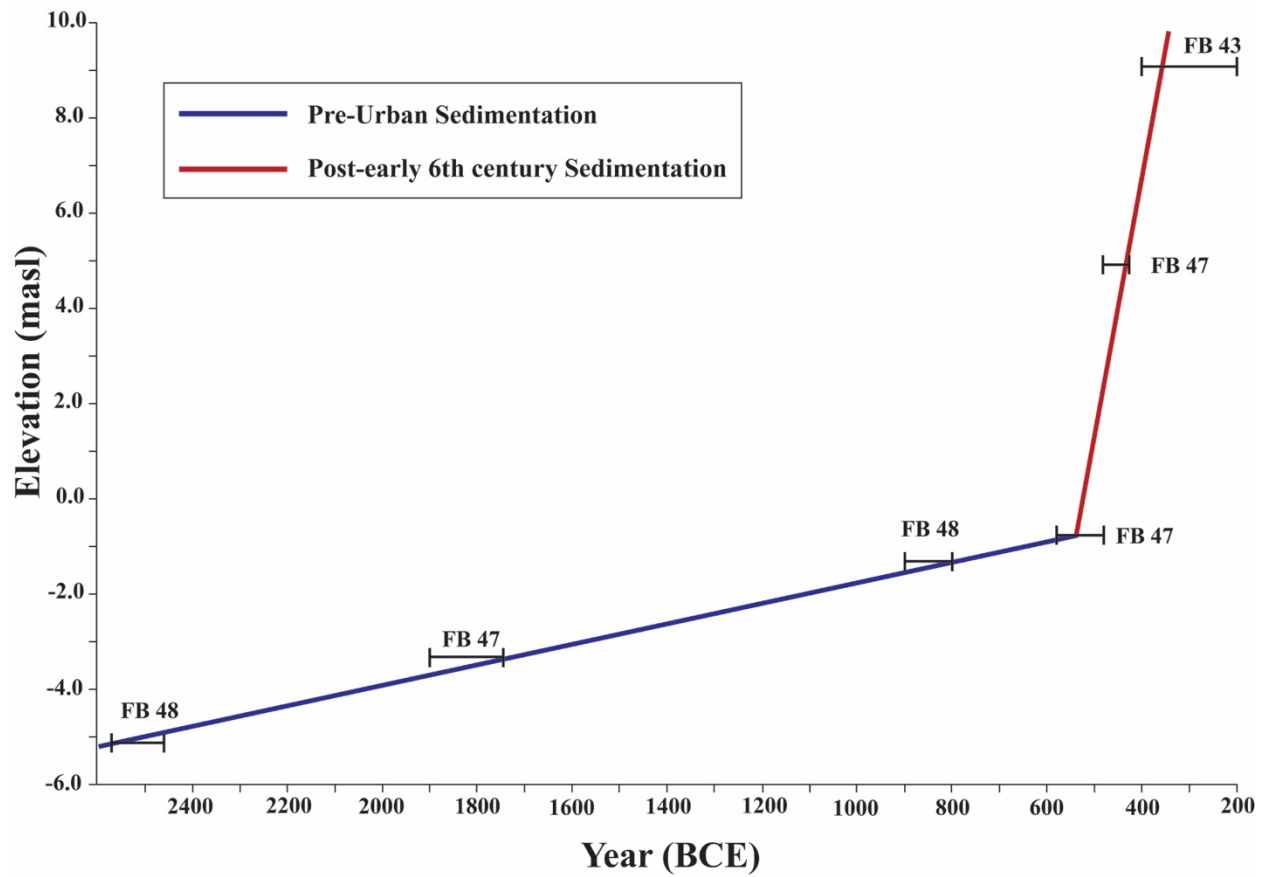


Fig. 38: Graph of the sedimentation rate in the Tiber channel in the Forum Boarium from the third through the first millennia BCE, showing a modest sedimentation rate of ca. 23cm/century prior to the early sixth century, after which 5.8m of sediment was deposited in a century

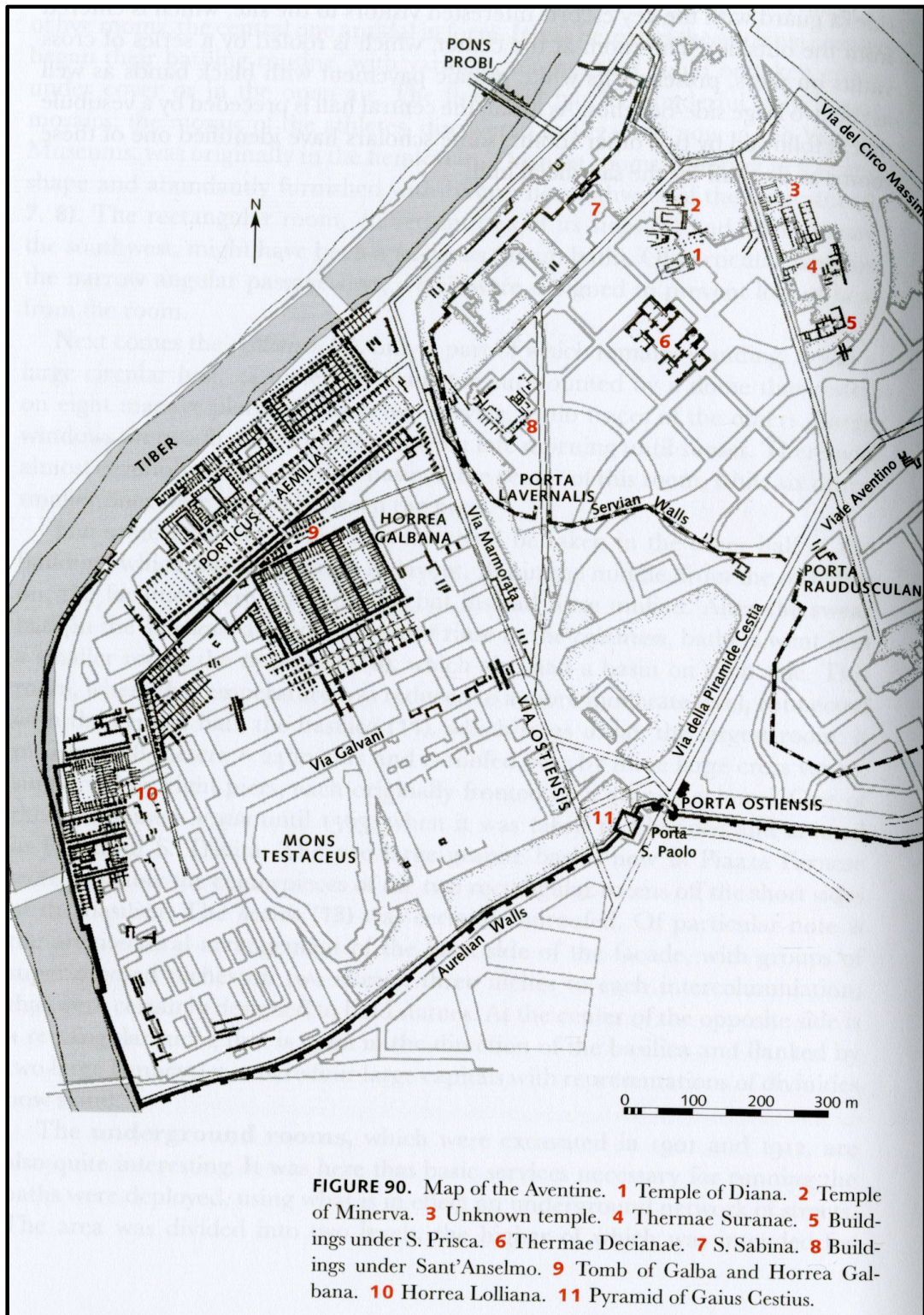


Fig. 39: Map of *emporium* infrastructure in the Testaccio region southeast of the Aventine Hill (Coarelli 2007, 332)

Bibliography

n.b.: The abbreviations for journals and book series are those recognized in the *American Journal of Archaeology* 94 (1990) 525-527.

Adam, J-P. 1994. *Le Temple de Portunus au Forum Boarium*. Rome: École Française de Rome.

Aldrete, G. S. 2007. *Floods of the Tiber in ancient Rome*. Baltimore: Johns Hopkins University Press.

Alföldi, A. 1965. *Early Rome and the Latins*. Ann Arbor: University of Michigan Press.

Alessandri, L. 2013. *Latium Vetus in the Bronze Age and Early Iron Age*. Oxford: BAR-IS 2565.

Ammerman, A.J. 1990. "On the Origins of the Forum Romanum." *AJA* 94: 627-645.

_____. 1995. "Environmental Setting." In *Palatium e Sacra Via. I, Prima delle mura, l'età delle mura e l'età case arcaiche*, edited by A. Carandini and P. Carafa, 87-101. Rome: Istituto Poligrafico e Zecca dello Stato.

_____. 1996. "The Comitium in Rome from the beginning." *AJA* 100: 121-136.

_____. 1998. "Environmental archaeology in the Velabrum, Rome: interim report." *JRA* 11: 213-223.

_____. 2000. "Velabrum (environmental setting)." In *Lexicon Topographicum Urbis Romae*, vol. 5, edited by E.M. Steinby, 101-102. Rome: Quasar.

_____. 2006. "Adding Time to Rome's Imago." In *Imaging Ancient Rome*, edited by L. Haselberger and J. Humphrey, 297-308. JRA Supplementary Series 61. Portsmouth: Journal of Roman Archaeology.

_____. 2011. "Relocating the Center: A Comparative Study." In *State Formation in Italy and Greece: Questioning the Neoevolutionist Paradigm*, edited by N. Terrenato and D.C. Haggis, 256-272. Oxford: Oxbow Books.

_____. 2013. "Looking at Early Rome with Fresh Eyes: Transforming the Landscape." In *A Companion to the Archaeology of the Roman Republic*, edited by J.D. Evans, 169-180. Chichester: Wiley Blackwell.

- Ammerman, A.J., and D. Filippi. 1998. "Il Nuovo Tempio del Velabro." *BullCom* 99: 272-76.
- _____. 2004. "Dal Tevere all'Argileto." *BullCom* 105: 7-28.
- Ammerman, A.J., and N. Terrenato. 1996. "Nuove osservazioni sul Colle Capitolino." *BullCom* 97: 35-46.
- Ammerman, A.J., J. Miller, and S. Ramsay. 2000. "The Mid-Holocene Environment of the Velabrum in Rome." *Quaderni della Società per la preistoria e protostoria della regione Friuli-Venezia Giulia* 8: 9-20.
- Ammerman, A.J., I. Iliopoulos, F. Bondioli, D. Filippi, J. Hilditch, A. Manfredini, L. Pennisi, and N.A. Winter. 2008. "The clay beds in the Velabrum and the earliest tiles in Rome." *JRA* 21: 7-30.
- Amorosi, A., M. Bini, S. Giacomelli, M. Pappalardo, C. Ribecai, V. Rossi, I. Sammartino, and G. Sarti. 2013. "Middle to late Holocene environmental evolution of the Pisa coastal plain (Tuscany, Italy) and early human settlements." *Quaternary International* 303: 93-106.
- Andel, T.H. van, C.N. Runnels, and K.O. Pope. 1986. "Five Thousand Years of Land Use and Abuse in the Southern Argolid, Greece." *Hesperia* 55: 103-128.
- Ando, C. 1999. "Was Rome a Polis?" *ClAnt* 18: 5-34.
- Andres, W., and J. Wunderlich. 1992. "Environmental Conditions for Early Settlement at Minshat Abu Omar, Eastern Nile Delta, Egypt." In *The Nile Delta in Transition: 4th-3rd millennium BC*, edited by E.C.M. van den Brink, 157-165. Tel Aviv: E.C.M. van den Brink.
- Angle, M., and A. Guidi. 2007. "L'antica e media età del bronzo nel Lazio meridionale." In *Strategie di insediamento fra Lazio meridionale e Campania centro-settentrionale in età preistorica e protostorica. Atti della XL Riunione Scientifica IIPP. Roma, Sala dello Stenditoio del MBAC, 30 Novembre – 3 Dicembre 2005*, 147-178. Florence: Istituto Italiano di Preistoria e Protostoria.
- Arnoldus-Huyzendveld, A., E. Pietroni, A. Palombini, M. Di Ioia, and V. Sanna. 2013. "Tiber valley virtual museum: 3D landscape reconstruction in the orientalising period, North of Rome." *Virtual Archaeology Review* 3: 97-101.

- Baglione, M.P., B. Belevi Marchesini, C. Carlucci, M.D. Gentili, and L.M. Michetti. 2015. "Pyrgi: A Sanctuary in the Middle of the Mediterranean Sea." In *Sanctuaries and the Power of Consumption: Networking and the Formation of Elites in the Archaic Western Mediterranean World. Proceedings of the International Conference in Innsbruck, 20-23 March 2012*, edited by E. Kistler, B. Öhlinger, M. Mohr, and M. Hoernes, 221-237. Wiesbaden: Harrassowitz Verlag.
- Barker, G. 1981. *Landscape and Society: Prehistoric Central Italy*. New York: Academic Press.
- _____. 1988. "Archaeology and the Etruscan Countryside." *Antiquity* 62: 772-785.
- Barker, G.W. and C.O. Hunt. 1995. "Quaternary valley floor erosion and alluviation in the Biferno Valley, Molise, Italy: The role of tectonics, climate, sea level change, and human activity." In *Mediterranean Quaternary River Environments*, edited by J. Lewin, M.G. Macklin, and J. Woodward, 145-158. Rotterdam: Balkema.
- Barker, G. and T. Rasmussen. 1998. *The Etruscans*. Malden: Blackwell Publishing.
- Baron, C.A. 2013. *Timaeus of Tauromenium and Hellenistic Historiography*. Cambridge: Cambridge University Press.
- Baroni, I. 2001. "Livelli di occupazione dell'età del Bronzo nel Giardino Romano: il Bronzo recente." *BullCom* 102: 291-298.
- Bartoloni, G. 2009. "I primi abitanti di Roma e di Veio." In *Gli Etruschi e Roma: Fasi monarchica e alto-repubblicana*, edited by G.M. Della Fina, 93-117. Rome: Quasar.
- Bauer, H. 1989. "Die Cloaca Maxima in Rom." *Mitteilungen des Leichtweiss-Instituts für Wasserbau der Technischen Universität Braunschweig* 103: 45-67.
- Bawden, G. and R.M. Reycraft, eds. 2000. *Environmental Disaster and the Archaeology of Human Response*. Albuquerque: Maxwell Museum of Anthropology.
- Beck, H. 2007. "The Early Roman Tradition." In *A Companion to Greek and Roman Historiography*, edited by J. Marincola, 259-265. Malden: Blackwell Publishing.
- Bell, M. 1982. "The Effects of Land-use and Climate on Valley Sedimentation." In *Climatic Change in Later Prehistory*, edited by A. Harding, 127-142. Edinburgh: Edinburgh University Press.
- Bellotti, P., G. Calderoni, M. G. Carboni, L. Di Bella, P. Tortora, P. Valeri, and V. Zernitskaya. 2007. "Late Quaternary landscape evolution of the Tiber River delta plain (Central Italy): new evidence from pollen data, biostratigraphy and 14C dating." *Zeitschrift für Geomorphologie* 51: 505-534.

- Bettelli, M. 1997. *Roma: la città prima della città: i tempi di una nascita: la cronologia delle sepolture ad inumazione di Roma e del Lazio nella prima età del ferro*. Rome: L'Erma di Bretschneider.
- Binford, L.R. 1965. "Archaeological Systematics and the Study of Culture Process." *American Antiquity* 31: 203-210.
- Bini, M., A. Chelli, A.M. Durante, L. Gervasini, and M. Pappalardo. 2009. "Geoarchaeological sea-level proxies from a silted up harbor: a case study of the Roman colony of Luni (northern Tyrrhenian Sea, Italy)." *Quaternary International* 206: 147-157.
- Bintliff, J.L. 1977. *Natural Environment and Human Settlement in Prehistoric Southern Greece*. Oxford: British Archaeological Reports, International Series 28.
- . 2000. "Landscape change in Classical Greece: a review." In *Geoarchaeology of the Landscapes of Classical Antiquity*, edited by F. Vermeulen and M. de Dapper, 49-70. Leuven: Babesch Supplement 5.
- Biserni, G. and B. van Geel. 2005. "Reconstruction of Holocene palaeoenvironment and sedimentation history of the Ombrone alluvial plain (South Tuscany, Italy)." *Review of Paleobotany and Palynology* 136: 16-28.
- Blackmann, D.J. 1982. "Ancient Harbours in the Mediterranean, Part 1." *IJNA* 11: 79-104.
- Blake, E. 2014. *Social Networks and Regional Identity in Bronze Age Italy*. Cambridge: Cambridge University Press.
- Blasi, C. 1994. Fitoclimatologia del Lazio. *Fitosociologia* 27: 151-175.
- Blasi, C., G. Dowgiallo, M. Follieri, F. Lucchese, D. Magri, S. Pignatti, and L. Sadori. 1995. "La vegetazione naturale potenziale dell'area romana." *Atti Accademia Nazionale dei Lincei* 115: 423-457.
- Bloch, R. 1960. *The Origins of Rome*. London: Praeger.
- Boëthius, A. 1978. *Etruscan and early Roman architecture*. New York: Penguin Books.
- Borrelli, P., P. Hoelzmann, D. Knitter, and B. Schütt. 2013. "Late Quaternary soil erosion and landscape development in the Apennine region (central Italy)." *Quaternary International* 312: 96-108.
- Borrelli, P., C. Domdey, P. Hoelzmann, D. Knitter, P. Panagos, and B. Schütt. 2014. "Geoarchaeological and historical implications of late Holocene landscape development in the Carseolani Mountains, central Apennines, Italy." *Geomorphology* 216: 26-39.

- Bozzano, F., A. Andreucci, M. Gaeta, and R. Salucci. 2000. "A Geological Model of the Buried Tiber River Valley beneath the Historical Centre of Rome." *Bulletin of Engineering Geology and the Environment* 59: 1–21.
- Bridge, J.S. 2003. *Rivers and Floodplains: forms, processes, and sedimentary record*. Malden: Blackwell Publishing.
- Brink, E. van den. 1993. "Settlement patterns in the Northeastern Nile Delta during the fourth-second millennia BC." In *Environmental Change and Human Culture in the Nile Basin and Northern African until the Second Millennium BC*, edited by L. Krzyzaniak, M. Kobusiewicz and J. Alexander, 279-304. Poznan: Poznan Archaeological Museum.
- Brizzi, B. 1994. *Il Tevere: un secolo di immagini*. second ed. Rome: Editore Colombo.
- Brocato, P. and N. Terrenato, eds. 2012. *Nuove ricerche nell'area archeologica di S.Omobono a Roma*. Arcavacata di Rende: Università della Calabria.
- . 2017. "The Archaic Temple of S. Omobono: New Discoveries and Old Problems." In *The Age of Tarquinius Superbus: Central Italy in the Late 6th Century*, edited by C. Smith and P. Lulof, 97-106. Leuven: Peeters.
- Brocato, P., A.M. Ramieri, N. Terrenato, I. Cangemi, M. D'Acri, L. De Luca, M. Giovagnoli, G. Pizzitutti, and C. Regoli. 2012. "La ripresa delle ricerche nell'area archeologica di S. Omobono a Roma." In *Mediterranea. Quaderni annuali dell'Istituto di studi sulle Civiltà italiche e del Mediterraneo antico* 9: 9-56.
- Brocato, P., M. Ceci, and N. Terrenato, eds. 2016. *Ricerche nell'area dei templi di Fortuna e Mater Matuta (Roma)*. Arcavacata di Rende: Università della Calabria.
- Brocchi, G.B. 1820. *Dello stato fisico del suolo di Roma: Memoria per servire d'illustrazione alla carta geognostica di questa città*. Rome: Nella Stamperia de Romanis.
- Brock, A.L. 2016a. "Envisioning Rome's Prehistoric River Harbor: An Interim Report from the Forum Boarium." *EtrStud* 19: 1-22.
- . 2016b. "Floodplain occupation and landscape modification in early Rome." *Quaternary International*, dx.doi.org/10.1016/j.quaint.2016.05.026.
- Brock, A.L. and N. Terrenato. 2016. "Rome in the Bronze Age: late second-millennium BC radiocarbon dates from the Forum Boarium." *Antiquity* 90: 654-664.
- Brown, A.G. 1997 *Alluvial Geoarchaeology: Floodplain archaeology and environmental change*. Cambridge: Cambridge University Press.
- Brown, T. 2002. "Floodplain landscapes and archaeology: fluvial events and human agency." *Journal of Wetland Archaeology* 2: 89-104.

- Brown, A.G. and C. Ellis. 1995. "People, Climate and Alluviation: Theory, Research Design and new Sedimentological and Stratigraphic Data from Etruria." *PBSR* 63: 45-73.
- Bunbury, J.M, A. Graham, and M.A. Hunter. 2008. "Stratigraphic Landscape Analysis: Charting the Holocene Movements of the Nile at Karnak through Ancient Egyptian Time." *Geoarchaeology* 23: 351-373.
- Büntgen, U., W. Tegel, K. Nicolussi, M. McCormick, D. Frank, V. Trouet, J.O. Kaplan, F. Herzig, K-U. Heussner, H. Wanner, J. Luterbacher, and J. Esper. 2011. "2500 Years of European Climate Variability and Human Susceptibility." *Science* 331: 578-582.
- Butzer, K. 1976. *Early Hydraulic Civilization in Egypt: a study in cultural ecology*. Chicago: University of Chicago Press.
- _____. 1982. *Archaeology as Human Ecology: Method and Theory for Contextual Approach*. Cambridge: Cambridge University Press.
- _____. 2005. "Environmental history in the Mediterranean world: cross-disciplinary investigation of cause and effect for degradation and soil erosion." *JAS* 32: 1773-1800.
- Buzzetti, C. 1999a. "Portunus, Aedes." In *Lexicon Topographicum Urbis Romae*, vol. 4, edited by E.M. Steinby, 153-154. Rome: Quasar.
- _____. 1999b. "Portus Tiberinus." In *Lexicon Topographicum Urbis Romae*, vol. 4, edited by E.M. Steinby, 155-156. Rome: Quasar.
- Campolunghi, M.P., G. Capelli, R. Funiciello, and M. Lanzini. 2008. "Processi di subsidenza nei depositi alluvionali olocenici nella città di Roma: caratteristiche stratigrafiche e geotecniche." In *La Geologia di Roma: dal centro storico alla periferia*, pt. 2, edited by R. Funiciello, A. Praturlon, and G. Giordano, 65-82. Florence: SELCA.
- Carafa, P. 1996. "Roma. II. Preistoria e Protostoria." In *Enciclopedia dell'Arte Antica Classica e Orientale, secondo supplemento*, 790-802. Rome: Istituto della Enciclopedia Italiana.
- _____. 2004. "Il Paesaggio Etrusco-Italico." In *Bridging the Tiber: Approaches to Regional Archaeology in the Middle Tiber Valley*, edited by H. Patterson, 45-59. London: The British School at Rome.
- Carandini, A. 1997. *La Nascita di Roma: dèi, lari, eroi e uomini all'alba di una civiltà*. Turin: Einaudi.
- _____. 2006. *Remo e Romolo: Dai rioni dei Quiriti alla città dei Romani*. Turin: Einaudi.
- _____. 2007. *Roma: il primo giorno*. Rome: La Terza.

- _____. 2012. "Urban landscapes and ethnic identity of early Rome." In *Landscape, Ethnicity and Identity in the Archaic Mediterranean Area*, edited by G. Cifani and S. Stoddart, 5-23. Oxford: Oxbow Books.
- Casson, L. 1965. "Harbour and River Boats of Ancient Rome." *JRS* 55: 31-39.
- Cazzella, A. 2001. "Sviluppi verso l'urbanizzazione a Roma alla luce dei recenti scavi nel Giardino Romano." *BullCom* 102: 265-68.
- Cazzella, A., I. Baroni, P. Boccuccia, F. Lugli and D. Tabò. 2007. "Testimonianze della media età del Bronzo sul Campidoglio." In *Strategie di insediamento fra Lazio meridionale e Campania centro-settentrionale in età preistorica e protostorica. Atti della XL Riunione Scientifica IIPP. Roma, Sala dello Stenditoio del MBAC, 30 Novembre – 3 Dicembre 2005*: 803-814. Florence: Istituto Italiano di Preistoria e Protostoria.
- Childe, V. 1928. *The Most Ancient Near East: The Oriental Prelude to European Prehistory*. London: Kegan Paul.
- Cifani, G. 2001. "Le origini dell'architettura in pietra a Roma." In *From Huts to Houses: Transformations of Ancient Societies*, edited by R. Brandt, L. Karlsson, and N. Tomkinson, 55-61. Proceedings of an International Seminar Organized by the Norwegian and Swedish Institutes in Rome (21-24 September 1997). Stockholm: Svenska Institutet in Rom.
- _____. 2008. *Architettura Romana Arcaica: Edilizia e Società tra Monarchia e Repubblica*. Rome: L'Erma di Bretschneider.
- _____. 2012. "Approaching ethnicity and landscapes in pre-Roman Italy: the middle Tiber Valley." In *Landscape, Ethnicity and Identity in the Archaic Mediterranean Area*, edited by G. Cifani and S. Stoddart, 144-162. Oxford: Oxbow Books.
- Cignini, B., G. Massari, and S. Pignatti. 1995. *L'ecosistema Roma*. Rome: Palombi.
- Ciotoli, G., G. Etiope, F. Marra, F. Florindo, C. Giraudi, and L. Ruggiero. 2016. "Tiber delta CO₂-CH₄ degassing: A possible hybrid, tectonically active Sediment-Hosted Geothermal System near Rome." *Journal of Geophysical Research, Solid Earth* 121. doi: 10.1002/2015JB012557.
- Coarelli, F. 1974. *Guida Archeologica di Roma*. Verona: A. Mondadori.
- _____. 1981. "Sull'area sacra di S. Omobono." *PP* 36: 35-8.
- _____. 1988. "I santuari, il fiume, gli emporia." In *Storia di Roma: I, Roma in Italia*, edited by A. Momigliano and A. Schiavone, 127-51. Turin: Giulio Einaudi.
- _____. 1992. *Il Foro Boario: dalle origini alla fine della Repubblica*. second ed. Rome: Quasar.

- _____. 1993. "Aemiliana." In *Lexicon Topographicum Urbis Romae*, vol. 1, edited by E.M. Steinby, 18-19. Rome: Quasar.
- _____. 1996. "Hercules Invictus, Ara Maxima." In *Lexicon Topographicum Urbis Romae*, vol. 3, edited by E.M. Steinby, 15-17. Rome: Quasar.
- _____. 1999. "Murus Romuli: Porta Mugonia, Mucionis, Mugonia." In *Lexicon Topographicum Urbis Romae*, vol. 4, edited by E.M. Steinby, 318. Rome: Quasar.
- _____. 2000. "Navalia." In *Lexicon Topographicum Urbis Romae*, vol. 3, edited by E.M. Steinby, 339-340. Rome: Quasar.
- _____. 2007. *Rome and Environs: An Archaeological Guide*. Berkeley: University of California Press.
- _____. 2011. *Le origini di Roma: la cultura artistica dalle origini al III secolo a.C.* Milan: Jaca Book.
- Colini, A.M. 1938. "Zona dei Fori Olitorio e Boario." *BullCom* 66: 279-282.
- _____. 1940. "L'area sacra di Sant'Omobono." *BullCom* 68: 75-76.
- _____. 1977. "Ambiente e storia dei tempi più antichi." *PP* 32: 9-19.
- _____. 1980. "Il porto fluviale del Foro Boario a Roma." In *The Seaborne Commerce of Ancient Rome: Studies in Archaeology and History*, edited by J.H. D'Arms and E.C. Kopff, 43-53. State College, PA: Pennsylvania State University Press.
- Colini, A.M., and C. Buzzetti. 1986a. "Portus Tiberinus." In *Il Tevere e le altre vie d'acqua del Lazio antico: settimo incontro di studio del comitato per l'archeologia laziale*, edited by S. Quilici Gigli, 157-97. Rome: Consiglio Nazionale delle Ricerche.
- _____. 1986b. "Aedes Portuni in Portu Tiberino." *BullCom* 91: 7-30.
- Colonna, G. 1974. "Preistoria e protostoria di Roma e del Lazio." In *Popoli e Civiltà dell'Italia Antica*, edited by B. D'Agostino, P. E. Arias, and G. Colonna, 273-346. Rome: Multigrafica.
- Cornell, T. 1978. "The Foundation of Rome in the Ancient Literary Tradition." In *Papers in Italian Archaeology I*, edited by H.M. Blake, T. Potter and D. Whitehouse, 131-140. Oxford: British Archaeological Reports.
- _____. 1986a. "The value of the literary tradition concerning archaic Rome." In *Social Struggles in Archaic Rome*, edited by K. Raaflaub, 52-76. Berkeley: University of California Press.

- _____. 1986b. "The Formation of the Historical Tradition of Early Rome." In *Past Perspectives*, edited by I.S. Moxon, J.D. Smart and A.J. Woodman, 67-86. Cambridge: Cambridge University Press.
- _____. 1995. *The Beginnings of Rome: Italy and Rome from the Bronze Age to the Public Wars (c. 1000-264 B.C.)*. London: Routledge.
- _____. 2001. "Cicero on the Origins of Rome." In *Cicero's Republic*, edited by J.G.F. Powell and J.A. North, 41-56. London: Institute of Classical Studies.
- _____, ed. 2013. *The Fragments of the Roman Historians*, vol. 1-3. Oxford: Oxford University Press.
- Costantini, L., and L. Costantini Biasini. 1989. "I vegetali dell'area sacra di S.Omobono." In *Il Viver Quotidiano in Roma Arcaica: Materiali dagli scavi del Tempio Arcaico nell'area sacra di S. Omobono*, 61-64. Rome: Procom
- Courty, M-A., P. Goldberg, and R.I. Macphail. 1989. *Soils and Micromorphology in Archaeology*. Cambridge: Cambridge University Press.
- Cozza, L. and Tucci, P.L. 2006. "Navalia." *Archaeologia Classica* 57: 175-202.
- Cressedi, G. 1949/51. "I Porti Fluviali in Roma Antica." *Atti della Pontificia Accademia Romana di Archeologia: Rendiconti* 24(6): 53-65
- Cressedi, G. 1984. "Il Foro Boario e il Velabro." *BullCom* 89: 249-96.
- Cristofani, M., ed. 1990. *La Grande Roma dei Tarquini: Roma, Palazzo delle Esposizioni, 12 giugno – 30 settembre 1990*. Rome: L'Erma di Bretschneider.
- D'Alessio, A. 2014. "L'edificio in opus incertum del Testaccio a Roma. Status quaestionis e prospettive di ricerca." In *Atlante Tematico di Topografia Antica. Atta 24. Roma, Città Romane, Assetto del Territorio*, edited by L. Quilici and S. Quilici Gigli, 7-23. Rome: L'Erma di Bretschneider.
- D'Amato, C. 1997. "Il plastico di Roma arcaica nel Museo della Civiltà Romana." *Bollettino dei Musei Comunali di Roma* 11: 139-43.
- D'Arms, J.H. 1974. "Puteoli in the Second Century of the Roman Empire: A Social and Economic Study," *JRS* 64: 104-24.
- Dann, R.J. 2015. "Introduction: Can Archaeology Save the World?" In *Climate and Ancient Societies*, edited by S. Kerner, R.J. Dann, P. Bangsgaard, 19-25. Copenhagen: Museum Tusculanum Press.

- Dawdy, S.L. 2006. "The Taphonomy of Disaster and the (Re)Formation of New Orleans." *American Anthropologist* 108: 719-730.
- _____. 2009. "Millennial Archaeology: Locating the discipline in the age of insecurity." *Archaeological Dialogues* 16: 131-142.
- De Santis, A. 2001. "Le sepolture di età protostorica a Roma." *BullCom* 102: 269-280.
- De Santis, A., G. Mieli, C. Rosa, R. Matteucci, A. Celant, C. Minniti, P. Catalano, F. De Angelis, S. Di Giannantonio, C. Giardino, and P. Giannini. 2010. "Le fasi di occupazione nell'area central di Roma in età protostorica: nuovi dati dagli scavi nel Foro di Cesare." *Scienze dell'Antichità* 16: 259-284.
- Delano Smith, C. 1978. "Coastal Sedimentation, Lagoons and Ports in Italy." In *Papers in Italian Archaeology I: The Lancaster Seminar: Recent Research in Prehistoric, Classical and Medieval Archaeology*, edited by H.M. Blake, T.W. Potter, and D.B. Whitehouse, 25-33. Oxford: BAR-IS 41.
- _____. 1979. *Western Mediterranean Europe: A Historical Geography of Italy, Spain and Southern France since the Neolithic*. New York: Academic Press.
- Demetriou, D. 2012. *Negotiating Identity in the Ancient Mediterranean: the Archaic and Classical Greek Multiethnic Emporia*. Cambridge: Cambridge University Press.
- Di Rita, F., A. Celant, and D. Magri. 2010. "Holocene environmental instability in the wetland north of the Tiber delta (Rome, Italy): sea-lake-man interactions." *Journal of Paleolimnology* 44: 51-67.
- Diamond, J. 2005. *Collapse: how societies choose to fail or succeed*. New York: Viking.
- Diffendale, D.P., P. Brocato, N. Terrenato, and A.L. Brock. 2016. "Sant'Omobono: an interim status quaestionis," *JRA* 29: 7-42.
- Dimbleby, G.W. 1976. "Climate, Soil and Man." *Philosophical Transactions of the Royal Society of London* 275 (936): 197-208.
- Dincauze, D.F. 2000. *Environmental Archaeology: principles and practice*. Cambridge: Cambridge University Press.
- Dirksen, H.E. 1824. *Uebersicht der bisherigen Versuche zur Kritik und Herstellung des Textes der Zwölftafeln-Fragmente*. Leipzig: J.C. Hinrichs.
- Drescher-Schneider, R., J-L. de Beaulieu, M. Magny, A-V. Walter-Simonnet, G. Bossuet, L. Millet, E. Brugiapaglia, and A. Drescher. 2007. "Vegetation history, climate and human impact over the last 15,000 years at Lago dell'Accesa (Tuscany, Central Italy)." *Vegetation History and Archaeobotany* 16: 279-299.

- Driessen, J. 2002. "Towards an archaeology of crisis: defining the long-term impact of the Bronze Age Santorini eruption." In *Natural Disasters and Cultural Change*, edited by R. Torrence and J. Grattan, 250-263. London: Routledge.
- Dufton, D. and T. Branton. 2010. "Climate change in early Egypt." *Egyptian Archaeology* 36: 36-37.
- Fabre, D. 2004/5. *Seafaring in Ancient Egypt*. London: Periplus.
- Farr, J., F. Marra, and N. Terrenato. 2015. "Geochemical identification criteria for "peperino" stones employed in ancient Roman buildings: a Lapis Gabinus case study." *Journal of Archaeological Science: Reports* 3: 41-51.
- Favro, D. 2005. "Making Rome a World City." In *The Cambridge Companion to the Age of Augustus*, edited by K. Galinsky, 234-263. Cambridge: Cambridge University Press.
- Fentress, E. and A. Guidi. 1999. "Myth, memory and archaeology as historical sources." *Antiquity* 73: 463-467.
- Ferring, C.R. 1992. "Alluvial Pedology and Geoarchaeological Research." In *Soils in Archaeology*, edited by V.T. Holliday, 1-40. Washington: Smithsonian Institution Press.
- Filippi, D. 2005. "Il Velabro e le origini del Foro." *Workshop di Archeologia Classica* 2: 93-115.
- Fiorini, L. 2015. "The Sacred Area of Gravisca: Ethnic and Religious Interactions in Comparison." In *Sanctuaries and the Power of Consumption: Networking and the Formation of Elites in the Archaic Western Mediterranean World. Proceedings of the International Conference in Innsbruck, 20-23 March 2012*, edited by E. Kistler, B. Öhlinger, M. Mohr, and M. Hoernes, 205-219. Wiesbaden: Harrassowitz Verlag.
- Flower, H. I. 2008. "Remembering and Forgetting Temple Destruction: The Destruction of the Temple of Jupiter Optimus Maximus in 83 BC." In *Antiquity in Antiquity: Jewish and Christian Pasts in the Greco-Roman World*, edited by G. Gardner and K. L. Osterlohm, 74-92. Tübingen: Mohr Siebeck.
- Forsythe, G. 1999. *Livy and Early Rome: a study in historical method and judgment*. Stuttgart: Franz Steiner.
- _____. 2005. *A Critical History of Early Rome*. Berkeley: University of California Press.
- Fraschetti, A. 2005. *The Foundation of Rome*. Edinburgh: Edinburgh University Press.
- Freitag, B., S. Bolton, F. Westerlund, and J.L.S. Clark. 2009. *Floodplain Management: A New Approach for a New Era*. Washington: Island Press.

- Frier, B.W. 1979. *Libri Annales Pontificum Maximorum: The Origins of the Annalistic Tradition*. Rome: American Academy in Rome.
- Fulani, S., F. Antonioli, S. Biolochi, T. Gambin, R. Gauci, V. Lo Presti, M. Anzidei, S. Devoto, M. Palombo, and A. Sulli. 2013. "Holocene sea level change in Malta." *Quaternary International*, 288: 146-157.
- Fulminante, F. 2012. "Ethnicity, identity and state formation in the Latin landscape. Problems and approaches." In *Landscape, Ethnicity and Identity in the Archaic Mediterranean Area*, edited by G. Cifani and S. Stoddart, 89-107. Oxford: Oxbow Books.
- _____. 2014. *The Urbanisation of Rome and Latium Vetus: from the Bronze Age to the Archaic Era*. Cambridge: Cambridge University Press.
- Funiciello, R., ed. 1995. *La geologia di Roma. Il centro storico. Memorie descrittive della Carta Geologica d'Italia*. Rome: Istituto Poligrafico e Zecca dello Stato.
- Funiciello, R., F. Marra, and C. Rosa. 1995. "Carta Geologica del Centro Storico di Roma," scale 1:10,000.
- Gabba, E. 1991. *Dionysius and the History of Archaic Rome*. Berkeley: University of California Press.
- _____. 2000. *Roma arcaica: storia e storiografia*. Rome: Edizioni di storia e letteratura.
- Gazda, E. 2001. "Cosa's Contribution to the Study of Roman Hydraulic Concrete: An Historiographic Commentary." In *New Light from Ancient Cosa: Classical Mediterranean Studies in Honor of Cleo Rickman Fitch*, edited by N.W. Goldman, 145-177. New York: Peter Lang Inc.
- Giaime, M., C. Morhange, M.A. Cau Ontiveros, J.J. Fornós, M. Vacchi, and N. Marriner. 2017. "In search of *Pollentia*'s southern harbor: Geoarchaeological evidence from the Bay of Alcúdia (Mallorca, Spain)." *Palaeogeography, Palaeoclimatology, Palaeoecology* 466: 184-201.
- Giampaola, D. and V. Carsana. 2005. "Le nuove scoperte: la città, il porto e le macchine." In *Eureka! Il genio degli antichi*, edited by E. Lo Sardo, 116-122. Naples: Electa Napoli.
- Giampaola, D., V. Carsana, and G. Boetto. 2004. "Il mare torna a bagnare Neapolis. Parte II: dalla scoperta del porto al recupero dei relitti." *L'Archeologo Subacqueo* 10: 15-19.
- Giampaolo, C., G. Lombardi, and M. Mariottini. 2008. "Pietre e costruito della città di Roma: dall'antichità ai giorni nostri." In *La Geologia di Roma: dal centro storico alla periferia*, pt. 1, edited by R. Funiciello, A. Praturlon, and G. Giordano, 273-406. Florence: SELCA.

- Giordano, G. 2008. "I vulcani di Roma: storia eruttiva e pericolosità." In *La Geologia di Roma: dal centro storico alla periferia*, pt. 1, edited by R. Funicello, A. Praturlon, and G. Giordano, 87-95. Florence: SELCA.
- Giordano, G., and R. Mazza. 2010. "The geology of Rome and urban areas: the legacy of Prof. Renato Funicello." *Journal of the Virtual Explorer* 36. doi: 10.3809/jvirtex.2010.00277.
- Giraudi, C. 2004. "Evoluzione tardo-olocenica del delta del Tevere." *Il Quaternario* 17: 477-492.
- _____. 2005. "Late-Holocene alluvial events in the Central Apennines, Italy." *The Holocene* 15: 768-773.
- Gjerstad, E. 1952. "Stratigraphic Excavations in the Forum Romanum." *Antiquity* 26: 60-64.
- _____. 1953. *Early Rome I*. Lund: C.W.K. Gleerup.
- _____. 1960. *Early Rome III: Fortifications, Domestic Architecture, Sanctuaries, Stratigraphic Excavations*. Lund: C.W.K. Gleerup.
- _____. 1962. "Scavo stratigrafico a S. Omobono." *BullCom* 77: 33-108.
- _____. 1966. *Early Rome IV: Synthesis of Archaeological Evidence*. Lund: C.W.K. Gleerup.
- Gladfelter, B.G. 1985. "On the Interpretation of Archaeological Sites in Alluvial Settings." In *Archaeological Sediments in Context*, edited by J.K. Stein and W.R. Farrand, 41-52. Orono, ME: Center for the Study of Early Man.
- Grandazzi, A. 1997. *The Foundation of Rome: Myth and History*. Ithaca: Cornell University Press.
- Gregory, K.J. 2006. "The human role in changing river channels." *Geomorphology* 79: 172-191.
- Gros, P. and M. Torelli. 2007. *Storia dell'urbanistica: il mondo romano*. Rome: Editori Laterza.
- Gruen, E. 1992. *Culture and National Identity in Republican Rome*. Ithaca, NY: Cornell University Press.
- Guilizzoni, P., A. Lami, A. Marchetto, V. Jones, M. Manca, and R. Bettinetti. 2002. "Palaeoproductivity and environmental changes during the Holocene in central Italy as recorded in two crater lakes (Albano and Nemi)." *Quaternary International* 88: 57-68.
- Gutzler, D.S. 2000. "Human Response to Environmental Disruption: a climatological perspective." In *Environmental Disaster and the Archaeology of Human Response*, edited by G. Bawden and R.M. Reycraft, 213-218. Albuquerque: Maxwell Museum of Anthropology.

- Haggis, D. 2002. "Integration and Complexity in the Late Prepalatial Period: A View from the Countryside in Eastern Crete." In *Labyrinth Revisited: Rethinking Minoan Archaeology*, edited by Y. Hamilakis, 120-142. Oxford: Oxbow.
- Harris, W.V. 1995. "The heir to 'Platner-Ashby.'" *JRA* 8: 365-375.
- _____. 2013. "Defining and Detecting Mediterranean Deforestation, 800 BCE to 700 CE." In *The Ancient Mediterranean Environment between Science and History*, edited by W.V. Harris, 173-194. Boston: Leiden.
- Hassan, F. 1997. "The Dynamics of a Riverine Civilization: A geoarchaeological perspective on the Nile Valley, Egypt." *World Archaeology* 29: 51-74.
- Heiken, G., R. Funicello, and D. De Rita. 2005. *The seven hills of Rome: a geological tour of the eternal city*. Princeton: Princeton University Press.
- Hesnard, A. 2004. "Vitruve, *De Architettura*, V, 12 et le port romain de Marseille." In *Le strutture dei porti e degli approdi antichi: Atti del II Seminario ANSER, Roma-Ostia Antica, 16-17 Aprile 2004*, edited by A. Gallina Zevi and R. Turchetti, 175-204. Soveria Mannelli: Rubbettino.
- Hill, H. 1961. "Dionysius of Halicarnassus and the Origins of Rome." *JRS* 51: 88-93.
- Holland, L.A. 1961. *Janus and the Bridge*. Rome: American Academy in Rome.
- Holliday, V.T. 2004. *Soils in Archaeological Research*. Oxford: Oxford University Press.
- Hooke, R.L. 2000. "On the history of humans as geomorphic agents." *Geology* 28: 843-846.
- Hopkins, J.N. 2007. "The Cloaca Maxima and the Monumental Manipulation of Water in Archaic Rome." *Waters of Rome* 4: 1-15.
- _____. 2012a. "The 'sacred sewer': tradition and religion in the Cloaca Maxima," In *Rome, Pollution, and Propriety: Dirt, Disease, and Hygiene in the Eternal City from Antiquity to Modernity*, edited by M. Bradley, 81-102. Cambridge: Cambridge University Press.
- _____. 2012b. "The Capitoline temple and the effects of monumentality on Roman temple design." In *Monumentality in Etruscan and Early Roman Architecture*, edited by M.L. Thomas and G.E. Meyers, 111-138. Austin: University of Texas Press.
- _____. 2014. "The Creation of the Forum and the Making of Monumental Rome." In *Papers on Italian Urbanism in the First Millennium BC*, edited by E.C. Robinson, 29-61. *JRA Supplementary Series 97*. Portsmouth, R.I.: Journal of Roman Archaeology.
- _____. 2016. *The Genesis of Roman Architecture*. New Haven: Yale University Press.

- Horden, P. and N. Purcell. 2000. *The Corrupting Sea: a study of Mediterranean History*. Oxford: Blackwell Publishing.
- Howard, A.J., M.G. Macklin, and D.G. Passmore, eds. 2000. *Alluvial Archaeology in Europe*. Lisse, The Netherlands: A.A. Balkema Publishers.
- Hughes, J.D. and J.V. Thirgood. 1982a. "Deforestation, Erosion, and Forest Management in Ancient Greece and Rome." *Journal of Forest History* 26: 60-75.
- _____. 1982b. "Deforestation in Ancient Greece and Rome: A Cause of Collapse." *Ecologist* 12: 196-208.
- Hunt, C.O. and D.D. Gilbertson. 1995. "Human activity, landscape change and valley alluviation in the Feccia Valley, Tuscany, Italy." In *Mediterranean Quaternary River Environments*, edited by J. Lewin, M.G. Macklin, and J. Woodward, 167-176. Rotterdam, NE: Balkema.
- Hunt, C., C. Malone, J. Sevink, and S. Stoddard. 1990. "Environment, Soils and Early Agriculture in Apennine Central Italy." *World Archaeology* 22: 34-44.
- Il Viver Quotidiano in Roma Arcaica: Materiali dagli scavi del Tempio Arcaico nell'area sacra di S. Omobono*. 1989. Rome: Procom.
- Ingold, T. 1993. "The Temporality of the Landscape." *World Archaeology* 25: 152-174.
- Ioppolo, G. 1972. "I reperti ossei animali nell'area archeologica di S. Omobono (1962-1964)." *RendPontAcc* 44: 3-46.
- Jackson, M. and F. Marra. 2006. "Roman stone masonry: volcanic foundations of the ancient city." *AJA* 110: 403-436.
- Jacobs, P.W. and D.A. Conlin. 2014. *Campus Martius: the Field of Mars in the life of ancient Rome*. New York: Cambridge University Press.
- Jacoby, F. 1923. *Die Fragmente der griechischen Historiker*, vol. 1-3. Leiden: Brill.
- Jones, W.H.S. 1907. *Malaria: A neglected factor in the history of Greece and Rome*. London: MacMillan and Co.
- Kampen, I van, A. Rathje, A. Celant, M. Follieri, J. De Grossi Mazzorin, and C. Minniti. 2005. "The Pre-Republican Habitation Layers of the Via Sacra in Giacomo Boni's Excavation of the Sepolcreto Arcaico." In *Papers in Italian Archaeology VI. Communities and Settlements from the Neolithic to the Early Medieval Period*, edited by P. Attema, A. Nijboer, A. Zifferero, 745-753. Oxford: Archaeopress.

- Kaplan, J.O., K.M. Krumhardt, and N. Zimmermann. 2009. "The prehistoric and preindustrial deforestation of Europe." *Quaternary Science Reviews* 28: 3016-3034.
- Karner, D.B., F. Marra, and P.R. Renne. 2001. "The history of the Monti Sabatini and Alban Hills volcanoes: groundwork for assessing volcanic-tectonic hazards for Rome." *Journal of Volcanology and Geothermal Research* 107: 185-219.
- Keenan-Jones, D. 2013. "Large-Scale Water Management Projects in Roman Central-Southern Italy." In *The Ancient Mediterranean Environment between Science and History*, edited by W.V. Harris, 233-256. Boston: Leiden.
- Kirch, P.V. 1980. "The Archaeological Study of Adaptation: Theoretical and Methodological Issues." *Advances in Archaeological Method and Theory* 3: 101-156.
- Kraft, J.C., G. Rapp, I. Kayan, J.V. Luce. 2003. "Harbor areas at ancient Troy: Sedimentology and geomorphology complement Homer's Iliad." *Geology* 31: 163-166.
- Lagunes, M.M.S. 2004. *Il Tevere e Roma: Storia di una simbiosi*. Rome: Gangemi Editore.
- Lambeck, K., F. Antonioli, A. Purcell, and S. Silenzi. 2004a. "Sea-level change along the Italian coast for the past 10,000yr." *Quaternary Science Reviews* 23: 1567-1598.
- Lambeck, K., M. Anzidei, F. Antonioli, A. Benini, and A. Esposito. 2004b. "Sea level in Roman time in the Central Mediterranean and implications for recent change." *Earth and Planetary Science Letters* 224: 563-575.
- Lambeck, K., F. Antonioli, M. Anzidei, L. Ferranti, G. Leoni, G. Scicchitano, and S. Silenzi. 2011. "Sea level change along the Italian coast during the Holocene and projections for the future." *Quaternary International* 232: 250-257.
- Lanciani, R. 1897. *The Ruins and Excavations of Ancient Rome*. New York: Blom.
- _____. 1902. *New Tales of Old Rome*. Boston: Houghton, Mifflin and Company.
- Levene, D.S. 2007. "Roman Historiography in the Late Republic." In *A Companion to Greek and Roman Historiography*, edited by J. Marincola, 275-289. Malden: Blackwell Publishing.
- Lewin, J., M.G. Macklin, and J. Woodward, eds. 1995. *Mediterranean Quaternary River Environments*. Rotterdam, NE: Balkema.
- Lewis, G. Cornewall. 1855. *An inquiry into the credibility of the early Roman history*. London: J.W. Parker.

- Lindenhout, E. van't. 2014. "Constructing urban landscapes in Latium Vetus in the archaic period." In *Papers on Italian Urbanism in the First Millennium B.C.*, edited by E.C. Robinson, 126-144. JRA Supplementary Series 97. Portsmouth, R.I.: Journal of Roman Archaeology.
- Lindvall, S. forthcoming. "Portus Tiberinus – the ancient river harbor of Rome revisited." *Tidsskriften Medusa*.
- Lowe, J.J., C.A. Accorsi, M. Bandini Mazzanti, A. Bishop, S. van der Kaars, L. Forlani, A.M. Mercuri, C. Rivalenti, P. Torri, and C. Watson. 1996. "Pollen stratigraphy of sediment sequences from lakes Albano and Nemi (near Rome) and from the central Adriatic spanning the interval from oxygen isotope stage 2 to present day." *Memorie dell'Istituto Italiano di Idrobiologia* 55: 71-98.
- Lugli, F., and C. Rosa. 2001. "Prime evidenze di opere di terrazzamento del Capitolium nell'età del Bronzo recente." *BullCom* 102: 281-290.
- Macklin, M.G., J. Lewin, and J.C. Woodward. 1995. "Quaternary Fluvial Systems in the Mediterranean Basin." In *Mediterranean Quaternary River Environments*, edited by J. Lewin, M. G. Macklin, and J.C. Woodward, 1-28. Rotterdam: A.A. Balkema.
- Manca, F., G. Capelli, F. La Vigna, R. Mazza, and A. Pascarella. 2014. "Wind-induced salt-wedge intrusion in the Tiber river mouth (Rome-Central Italy)." *Environmental Earth Sciences* 72: 1083-1095.
- Marinatos, S. 1939. "The volcanic destruction of Minoan Crete." *Antiquity* 13: 425-439.
- Marra, F., C. Rosa, D. De Rita, and R. Funiciello. 1998. "Stratigraphic and Tectonic Features of the Middle Pleistocene Sedimentary and Volcanic Deposits in the area of Rome (Italy)." *Quaternary International* 47/48: 51-63.
- Marra, F., F. Florindo, and E. Boschi. 2008. "The history of glacial terminations from the Tiber River (Rome): insights to glacial forcing mechanisms." *Paleoceanography* 23. doi: 10.1029/2007PA001543.
- Marra, F., D. Deocampo, M.D. Jackson, G. Ventura. 2011. "The Alban Hills and Monti Sabatini volcanic products used in ancient Roman masonry (Italy): An integrated stratigraphic, archaeological, environmental and geochemical approach." *Earth Science Reviews* 108: 115-136.
- Marra, F., F. Bozzano, and F.R. Cinti. 2013. "Chronostratigraphic and Lithologic Features of the Tiber River Sediments (Rome, Italy): Implications on the Post-Glacial Sea-Level Rise and Holocene Climate." *Global and Planetary Change* 107: 157-76.

- Marra, F., E.J. Rohling, F. Florindo, B. Jicha, S. Nomade, A. Pereira, and P.R. Renne. 2016a. "Independent $^{40}\text{Ar}/^{39}\text{Ar}$ and ^{14}C age constraints on the last five glacial terminations from the aggradational successions of the Tiber River, Rome (Italy)." *Earth and Planetary Science Letters* 449: 105-117.
- Marra, F., P. Macri, and F. Florindo. 2016b. "Preliminary Results of Paleomagnetic Investigations of Boreholes from the Forum Boarium." Unpublished technical report.
- Marriner, N. and C. Morhange. 2005. "Under the city centre, the ancient harbor. Tyre and Sidon: heritages to preserve." *Journal of Cultural Heritage* 6: 183-189.
- . 2006. "Geoarchaeological evidence for dredging in Tyre's ancient harbor, Levant." *Quaternary Research* 65: 164-171.
- Marriner, N., C. Morhange, and C. Doumet-Serhal. 2006. "Geoarchaeology of Sidon's ancient harbours, Phoenicia." *JAS* 33: 1514-1535.
- Marriner, N., C. Morhange, and N. Carayon. 2008. "Ancient Tyre and its harbours: 5000 years of human-environment interactions." *JAS* 35: 1281-1310.
- Marsh, G.P. 1867. *Man and nature, or Physical Geography as modified by human action*. New York: C. Scribner & co.
- Mather, A.S., C.L. Needle, and J. Fairbairn. 1998. "The human drivers of global land cover change: the case of forests." *Hydrological Processes* 12: 1983-1994.
- Matthews, J. 2007. "The Emperor and his Historians." In *A Companion to Greek and Roman Historiography*, edited by J. Marincola, 290-304. Malden: Blackwell Publishing.
- Meiggs, R. 1982. *Trees and Timber in the Ancient Mediterranean World*. Oxford: Clarendon Press.
- Menne, B. and V. Murray, eds. 2013. *Floods in the WHO European Region: health effects and their prevention*. Geneva: WHO Press.
- Menotti, F. 2002. "Climatic change, flooding and occupational hiatus in the lake-dwelling central European Bronze Age." In *Natural Disasters and Cultural Change*, edited by R. Torrence and J. Grattan, 235-249. London: Routledge.
- Mercuri, A.M. and L. Sadori. 2014. "Mediterranean culture and climatic change: Past patterns and future trends." In *The Mediterranean Sea: Its history and present challenges*, edited by S. Goffredo and Z. Dubinsky, 507-527. Dordrecht: Springer.

- Mertens-Horn, M. 1994. "Corinto e l'Occidente nelle immagini. La nascita di Pegaso e la nascita di Afrodite." In *Istituto per la storia e l'archeologia della Magna Grecia, Corinto e l'Occidente: Atti del trentatreesimo Convegno di studi sulla Magna Grecia: Taranto, 8-13 ottobre 1993*, 257-289. Taranto: Istituto per la storia e l'archeologia della Magna Grecia.
- Meyers, G.E. 2003. "Etrusco-Italic Monumental Architectural Space from the Iron Age to the Archaic Period: An Examination of Approach and Access." Ph.D. diss., University of Texas at Austin.
- Millar, F. 1964. *A Study of Cassius Dio*. Oxford: Clarendon Press.
- Mocchegiani Carpano, C. 1984. "Le cloache dell'antica Roma." In *Roma Sotterranea*, edited by R. Luciani, 164-178. Rome: Fratelli Palombi Editori.
- Mogetta, M. 2015. "A New Date for Concrete in Rome." *JRS* 105: 1-40.
- _____. 2016. "The early development of concrete in the domestic architecture of pre-Roman Pompeii." *JRA* 29: 43-72.
- Momigliano, A. 1963. "An Interim Report on the Origins of Rome." *JRS* 53: 95-121.
- _____. 1989. "The origins of Rome." *CAH*² 7.2: 52-112.
- Mommsen, T. 1868. *Römische Geschichte*, vol. 1. Berlin: Weidmannsche Buchhandlung.
- Morel, J-P. 1975. "L'Expansion Phocéenne en Occident: dix années de recherches (1966-75)." *BCH* 99: 853-896.
- Morelli, C., G. Olcese, F. Zevi. 2004 "Scoperte recenti nelle saline portuensi (*Campus salarius romanarum*) e un progetto di ricerca sulla ceramica di area ostiense in età repubblicana." In *Méditerranée occidentale antique: les échanges. Atti del seminario (Marsiglia, 14-15 maggio 2004)*, edited by A. Gallina Zevi and R. Turchetti, 43-55. Soveria Mannelli: Rubbettino Editore.
- Morhange, C., F. Blanc, S. Schmitt-Mercury, M. Bourcier, P. Carbonel, C. Oberlin, A. Prone, D. Vivent, and A. Hesnard. 2003. "Stratigraphy of late-Holocene deposits of the ancient harbor of Marseilles, southern France." *The Holocene* 13: 593-604.
- Morhange, C. and N. Marriner. 2010. "Mind the (stratigraphic) gap: Roman dredging in ancient Mediterranean harbours." *Bollettino di Archeologia on line* B/B7/4: 23-32.
- Morley, N. 1996. *Metropolis and hinterland: The city of Rome and the Italian economy 200 B.C.-A.D. 200*. Cambridge: Cambridge University Press.

- Mosely, M.E. 2000. "Confronting Natural Disaster." In *Environmental Disaster and the Archaeology of Human Response*, edited by G. Bawden and R.M. Reycraft, 219-223. Albuquerque: Maxwell Museum of Anthropology.
- Motta, L. 2002. "Planting the seed of Rome." *Vegetation History and Archaeobotany* 11: 71-77.
- _____. 2011. "The seed of the Roman State. Archaeobotanical assemblages from Archaic Rome." Ph.D. diss., University of Cambridge.
- Mura Sommella, A. 2000a. "Le recenti scoperte sul Campidoglio e la fondazione del tempio di Giove Capitolino." *Atti della Pontificia Accademia romana di archeologia: Rendiconti* 70: 57-79.
- _____. 2000b. "'La grande Roma dei Tarquini': Alterne vicende di una felice intuizione." *BullCom* 101: 7-26.
- Nicosia, C. 2017. "Area Sacra S. Omobono (Rome). Soil Micromorphology Technical Report – 2015 Cores." Unpublished technical report.
- Ogilvie, R.M. and A. Drummond. 1989. "The sources for early Roman history." *CAH*² 2.2: 1-29.
- Oldfield, F. 1996. "The PALICLAS Project: synthesis and overview." *Memorie dell'Istituto Italiano di Idrobiologia* 55: 329-337.
- Oleson, J.P. 1988. "The technology of Roman harbours." *The International Journal of Nautical Archaeology and Underwater Exploration* 17: 147-157.
- O'Sullivan, L. A. Jardine, A. Cook, and P. Weinstein. 2008. "Deforestation, Mosquitoes, and Ancient Rome: Lessons for Today." *BioScience* 58: 756-760.
- Pais, E. 1905. *Ancient Legends of Roman History*. New York: Dodd, Mead and Company.
- Pallottino, M. 1979. "The Origins of Rome: a survey of recent discoveries and discussions." In *Italy before the Romans: the Iron Age, Orientalizing, and Etruscan Periods*, edited by D. and F. Ridgway, 197-222. London: Academic Press.
- _____. 1991. *A History of Earliest Italy*. Translated by M. Ryle and K. Soper. Ann Arbor: University of Michigan Press.
- Parotto, M. 2008. "Evoluzione paleogeografica dell'area romana: una breve sintesi." In *La Geologia di Roma: dal centro storico alla periferia*, pt. 1, edited by R. Funicello, A. Praturlon, and G. Giordano, 25-38. Florence: SELCA.
- Pasquali, G. 1936. "La grande Roma dei Tarquini." *Nuova Antologia* 308: 405-416.

- Patterson, H., ed. 2004. *Bridging the Tiber: Approaches to Regional Archaeology in the Middle Tiber Valley*. London: The British School at Rome.
- Patterson, H., H. di Giuseppe, and R. Witcher. 2004. "Three South Etruria 'Crises': First Results of the Tiber Valley Project." *PBSR* 72: 1-36.
- Pelling, C. 2007. "The Greek Historians of Rome." In *A Companion to Greek and Roman Historiography*, edited by J. Marincola, 244-258. Malden: Blackwell Publishing.
- Peroni, R. 1962. "S. Omobono: Materiali dell'età del bronzo e degli inizi dell'età del ferro." *BullCom* 77: 7-32.
- _____. 1971. *L'età del bronzo nella penisola italiana: I, L'antica età del bronzo*. Florence: L.S. Olschki.
- Petropoulos, E.K. 2005. Hellenic Colonization in Euxeinos Pontos: Penetration, Early Establishment, and the Problem of the "Emporion" Revised. Oxford: BAR-IS 1394.
- Piccarreta, M., M. Caldara, D. Capolongo, and F. Boenzi. 2011. "Holocene geomorphic activity related to climate change and human impact in Basilicata, Southern Italy." *Geomorphology* 128: 137-147.
- Pisani Sartorio, G. 1995. "Fortuna et Mater Matuta, Aedes." In *Lexicon Topographicum Urbis Romae*, vol. 2, edited by E.M. Steinby, 281-285. Rome: Quasar.
- Pisani Sartorio, G. and P. Virgili. 1979. "Area sacra di S. Omobono." *Archeologia Laziale II, Quaderni del Centro di Studio per l'Archeologia Etrusco-Italica* 3: 41-47.
- Platner, S.B., and T. Ashby. 1929. *A Topographical Dictionary of Ancient Rome*. London: Oxford University Press.
- Pomey, P. 1995. "Les épaves grecques et romaines de la place Jules Verne à Marseille." *Comptes Rendus des séances de l'Académie des Inscriptions et Belles Lettres* 139: 459-484.
- Pomey, P. and E. Rieth. 2005. *L'Archéologie Navale*. Paris: Editions Errance.
- Pope, K.O. and T.H. van Andel. 1984. "Late Quaternary Alluviation and Soil Formation in the Southern Argolid: its History, Causes and Archaeological Implications." *JAS* 11: 281-306.
- Potter, T.W. 1979. *The Changing Landscape of South Etruria*. London: Elek.
- Potts, C. 2011. "The Development and Architectural Significance of Early Etrusco-Italic Podia." *BABESCH* 86: 41-52.

- _____. 2015. *Religious Architecture in Latium and Etruria, c. 900-500 BC*. Oxford: Oxford University Press.
- Pucci, S., D. Pantosti, P.M. De Martini, A. Smedile, M. Munzi, E. Cirelli, M. Pentiricci, and L. Musso. 2011. "Environment-human relationships in historical times: the balance between urban development and natural forces at Leptis Magna (Libya)." *Quaternary International* 242: 171-184.
- Purcell, N. 1996. "The Ports of Rome: Evolution of a façade maritime." In *Roman Ostia Revisited: Archaeological and Historical Papers in Memory of Russell Meiggs*, edited by A. Zevi and A. Claridge, 267-79. London: British School at Rome.
- _____. 2012. "Urban spaces and central places: the Roman world." In *Classical Archaeology*, edited by S.E. Alcock and R. Osborne, 187-206. Malden: Wiley-Blackwell.
- Quilici, L. 1979. *Roma primitiva e le origini della civiltà laziale*. Rome: Newton Compton.
- _____. 1995. "Il plastico di Roma arcaica al Museo della Civiltà Romana." *Ocnus* 3: 143-55.
- Quilici Gigli, S. 1986. "Scali e raghetti sul Tevere in epoca arcaica." In *Il Tevere e le altre vie d'acqua del Lazio antico: settimo incontro di studio del comitato per l'archeologia laziale*, edited by S. Quilici Gigli, 71-89. Rome: Consiglio Nazionale delle Ricerche.
- Quinn, A.D. 1961. *Design and Construction of Ports and Marine Structures*. New York: McGraw-Hill Book Company.
- Rapp, G. and C.L. Hill 2006. *Geoarchaeology: The Earth-Science Approach to Archaeological Interpretation*, second ed. New Haven: Yale University Press.
- Rawson, E. 1972. "Cicero the Historian and Cicero the Antiquarian." *JRS* 62: 33-45.
- _____. 1976. "The First Latin Annalists." *Latomus* 35: 689-717.
- _____. 1989. "Roman tradition and the Greek world." *CAH²* 8: 422-476.
- Rea, J.A. 2007. *Legendary Rome: Myth, Monuments, and Memory on the Palatine and Capitoline*. London: Duckworth.
- Reimer, P.J., E. Bard, A. Bayliss, J.W. Beck, P.G. Blackwell, C.B. Ramsey, C.E. Buck, H. Cheng, R.L. Edwards, M. Friedrich, P.M. Grootes, T.P. Guilderson, H. Haflidason, I. Hajdas, C. Hatté, T.J. Heaton, D.L. Hoffmann, A.G. Hogg, K.A. Hughen, K.F. Kaiser, B. Kromer, S.W. Manning, M. Niu, R.W. Reimer, D.A. Richards, E.M. Scott, J.R. Southon, R.A. Staff, C.S.M. Turney, and J. Van der Plicht. 2013. "IntCal13 and Marine13 Calibration Curves, 0-50,000 years cal BP." *Radiocarbon* 55: 1869-1887.

- Renfrew, C. 1972. *The Emergence of Civilisation: The Cyclades and the Aegean in the Third Millennium BC*. London: Methuen & Co LTD.
- Reycraft, R.M. and G. Bawden. 2000. "Introduction." In *Environmental Disaster and the Archaeology of Human Response*, edited by G. Bawden and R.M. Reycraft, 1-10. Albuquerque: Maxwell Museum of Anthropology.
- Richardson, L. 1992. *A New Topographical Dictionary of Ancient Rome*. Baltimore: Johns Hopkins University Press.
- Rickman, G.E. 1988. "The archaeology and history of Roman ports." *The International Journal of Nautical Archaeology and Underwater Exploration* 17: 257-267.
- Ridgway, D. and F.R. Ridgway. 1994. "Demaratus and the Archaeologists." In *Murlo and the Etruscans: art and society in ancient Etruria*, edited by R.D. De Puma and J.P. Small, 6-15. Madison: University of Wisconsin Press.
- Riva, C. and S. Stoddart. 1996. "Ritual landscapes in archaic Etruria." In *Approaches to the Study of Ritual: Italy and the Ancient Mediterranean*, edited by J. Wilkins, 91-109. London: Accordia Research Centre.
- Ruggiero, I. 1991/92. "Ricerche sul tempio di Portuno nel Foro Boario: per una rilettura del monumento." *BullCom* 94: 253-86.
- Runnels, C. 2000. "Anthropic Soil Erosion in Prehistoric Greece: the contribution of regional surveys to the archaeology of environmental disruptions and human response." In *Environmental Disaster and the Archaeology of Human Response*, edited by G. Bawden and R.M. Reycraft, 11-20. Albuquerque: Maxwell Museum of Anthropology.
- Sadori, L., C. Giraudi, P. Petitti, and A. Ramrath. 2004. "Human impact at Lago di Mezzano (central Italy) during the Bronze Age: a multidisciplinary approach." *Quaternary International* 113: 5-17.
- Sallares, R. 2002. *Malaria and Rome: A History of Malaria in Ancient Italy*. Oxford: Oxford University Press.
- Sayers, P.B., M.S. Horritt, E. Penning-Rowsell, and A. McKenzie. 2015. *Climate Change Risk Assessment 2017: Projects of future flood risk in the UK*. London: Committee on Climate Change.
- Schiffer, M.B. 1987. *Formation Processes of the Archaeological Record*. Albuquerque: University of New Mexico Press.
- Schultze, C. 2000. "Authority, Originality and Competence in the Roman Archaeology of Dionysius of Halicarnassus." *Histos* 4: 6-49.

- Serrati, J. 2006. "Neptune's Altars: The treaties between Rome and Carthage (509-226 BC)." *CQ* 56: 113-134.
- Severgnini, B. 2016. "Italy's Fragile Beauty." *The New York Times*, published August 24.
- Sewell, D. 1969. "Human response to floods." In *Water, Earth, and Man: a Synthesis of Hydrology, Geomorphology and Socio-economic Geography*, edited by R.J. Chorley, 431-451. London: Methuen.
- Smith, C. 1995. "The Beginnings of Urbanization in Rome." In *Mediterranean Urbanization 800-600BC*, edited by R. Osborne and B. Cunliffe, 91-112. Oxford: Oxford University Press.
- _____. 1996. *Early Rome and Latium: Economy and Society c. 1000 to 500 BCE*. Oxford: Clarendon Press.
- _____. 1997. "Servius Tullius, Cleisthenes and the emergence of the *polis* in Central Italy." In *The Development of the 'Polis' in Archaic Greece*, edited by L.G. Mitchell and P.J. Rhodes, 208-216. London: Routledge.
- _____. 1999. "Medea in Italy: Barter and Exchange in the Archaic Mediterranean." In *Ancient Greeks West and East*, edited by G.R. Tsetschladze, 179-206. Leiden: Brill.
- _____. 2000. "Worshipping Mater Matuta: ritual and context." In *Religion in Archaic and Republican Rome and Italy: Evidence and Experience*, edited by E. Bispham and C. Smith, 136-155. Chicago: Fitzroy Dearborn Publishers.
- _____. 2007. "Latium and the Latins: The Hinterland of Rome." In *Ancient Italy: regions without boundaries*, edited by G.J. Bradley, E. Isayev, and C. Riva, 161-178. Exeter: University of Exeter Press.
- _____. 2016. "The Pyrgi Tablets and the View from Rome." In *Le Lamine di Pyrgi: nuovi studi sulle iscrizioni in etrusco e in fenicio nel cinquantenario della scoperta*, edited by V. Bellelli and P. Xella, 203-221. Verona: Essedue Edizioni.
- Snowden, F. 2006. *The Conquest of Malaria: Italy, 1900-1962*. New Haven: Yale University Press.
- Soren, D. and N. Soren. 1995. "What killed the babies of Lugnano?" *Archaeology* 48: 43-48.
- _____, eds. 1999. *A Roman villa and a late Roman infant cemetery: excavation at Poggio Gramignano, Lugnano in Teverina*. Rome: Bibliotheca Archaeologica.
- Stein, J.K. 1985. "Interpreting Sediments in Cultural Settings." In *Archaeological Sediments in Context*, edited by J.K. Stein and W.R. Farrand, 5-20. Orono, ME: Center for the Study of Early Man.

- _____. 1992. "Organic Matter in Archaeological Contexts." In *Soils in Archaeology: Landscape Evolution and Human Occupation*, edited by V.T. Holliday, 193-216. Washington: Smithsonian Institution Press.
- _____. 2001. "Archaeological Sediments in Cultural Environments." In *Sediments in Archaeological Context*, edited by J.K. Stein and W.R. Farrand, 1-28. Salt Lake City: University of Utah Press.
- Stock, F., A. Pint, B. Horejs, S. Ladstätter, and H. Brückner. 2013. "In search of the harbours: new evidence of late Roman and Byzantine harbours of Ephesus." *Quaternary International* 312: 57-69.
- Stoddart, D.R. 1969. "World Erosion and Sedimentation." In *Water, Earth, and Man: a synthesis of hydrology, geomorphology and socio-economic geography*, edited by R. Chorley, 43-64. London: Methuen.
- Suro, R. 1988. "Newly found wall may give clue to origin of Rome, scientist says." *The New York Times*, published June 10.
- Tagliacozzo, A. 1989. "Analisi dei resti faunistici dell'area sacra di S. Omobono." In *Il Viver Quotidiano in Roma Arcaica: Materiali dagli scavi del Tempio Arcaico nell'area sacra di S. Omobono*, 65-69. Rome: Procom.
- Tagliamonte, G. 1996. "Iuppiter Optimus Maximus Capitolinus, Aedes, Templum." In *Lexicon Topographicum Urbis Romae*, vol. 3, edited by E.M. Steinby, 144-148. Rome: Quasar.
- Talma, A.S., and J.C. Vogel. 1993. "A Simplified Approach to Calibrating ¹⁴C Dates." *Radiocarbon* 35: 317-322.
- Taylor, R. 2002. "Tiber River Bridges and the Development of the Ancient City of Rome." *The Waters of Rome* 2: 1-20.
- Terrenato, N. 1992. "Velia and Carinae: some observations on an area of Archaic Rome." *New Developments in Italian Archaeology. Papers of the Fourth Conference of Italian Archaeology* 4: 31-47.
- _____. 1999. "Murus Romuli." In *Lexicon Topographicum Urbis Romae*, vol. 4, edited by E.M. Steinby, 315-317. Rome: Quasar.
- _____. 2001. "The Auditorium site in Rome and the origins of the villa." *JRA* 14: 5-32.
- _____. 2011. "The Versatile Clans: Archaic Rome and the nature of Early City-States in Central Italy." In *State Formation in Italy and Greece: Questioning the Neoevolutionist Paradigm*, edited by N. Terrenato and D.C. Haggis, 231-244. Oxford: Oxbow Books.

- Terrenato, N. and D.C. Haggis, eds. 2011. *State Formation in Italy and Greece: questioning the neoevolutionist paradigm*. Oxford: Oxbow Books.
- Terrenato, N., P. Brocato, G. Caruso, A.M. Ramieri, H.W. Becker, I. Cangemi, G. Mantiloni, and C. Regoli. 2012. "The S.Omobono Sanctuary in Rome: Assessing Eighty Years of Fieldwork and Exploring Perspectives for the Future." *Internet Archaeology* 31. doi: <http://dx.doi.org/10.11141/ia.31.1>
- Testa, O., M.P. Campolunghi, R. Funicello, M. Lanzini. 2008. "Il problema dei riporti e le modificazioni della forma originaria." In *La Geologia di Roma: dal centro storico alla periferia*, pt. 1, edited by R. Funicello, A. Praturlon, and G. Giordano, 145-168. Florence: SELCA.
- Thomas, E. and C. Witschel. 1992. "Constructing Reconstruction: Claim and Reality of Roman Rebuilding Inscriptions from the Latin West." *PBSR* 60: 135-177.
- Thommen, L. 2012. *An Environmental History of Ancient Greece and Rome*. Translated by P. Hill. Cambridge: Cambridge University Press.
- Thomsen, R. 1980. *King Servius Tullius: a historical synthesis*. Copenhagen: Gyldendalske Boghandel.
- Tolotti, F. 1992. "Sugli edifici antichi di S. Maria in Cosmedin." In *Il Foro Boario: dalle origini alla fine della Repubblica*, edited by F. Coarelli, 439-442. Rome: Quasar.
- Torrence, R. and J. Grattan, eds. 2002a. *Natural Disasters and Cultural Change*. London: Routledge.
- _____. 2002b. "The archaeology of disasters: past and future trends." In *Natural Disasters and Cultural Change*, edited by R. Torrence and J. Grattan, 1-18. London: Routledge.
- Toynbee, A.J. 1970. "The Setting: Rome as Mistress of Italy." In *Imperialism in the Roman Republic*, edited by E. Gruen, 10-17. New York: Holt, Rinehart and Winston.
- Timpe, D. 1970. "Le Origini di Catone e la storiografia Latina." *Atti e Memorie dell' Accademia Patavina di Scienze, Lettere ed Arti, Classe di Sc. Mor.*: 5-33.
- _____. 1972. "Fabius Pictor und die Anfänge der römischen Historiographie." *ANRW* 1.2: 928-969.
- Torelli, M. 1977. "Il santuario greco di Gravisca." *PP* 32: 398-458.
- _____. 1982. "Per la definizione del commercio greco-orientale: il caso di Gravisca." *PP* 37: 304-325.

- _____. 1986. "Tarquinia and its Emporion at Gravisca: A case in maritime trade in the VIth century B.C." *Thracia Pontica* 3: 46-53.
- _____. 1989. "Archaic Rome between Latium and Etruria." *CAH*² 2.2: 30-51.
- _____. 1990. "Archaic Rome between Latium and Etruria." *CAH* 7(2): 30-51.
- Tucci, P.L. 2011/12. "The Pons Sublicius: A Reinvestigation." *MAAR* 56/57: 177-212.
- _____. 2012. "La controversa storia della 'porticus Aemilia.'" *Archeologia Classica* 63: 575-591.
- Tuck, S.L. 2000. "A new identification for the 'Porticus Aemilia'." *JRA* 13: 176-182.
- Ucko, P., R. Tringham, and G.W. Dimbleby, eds. 1972. *Man, Settlement, and Urbanism*. Cambridge, Mass: Schenkman Publishing Co.
- Ventriglia, U. 1971. *La geologia della città di Roma*. Rome: Bardi.
- Virgili, P. 1999. "Vicus Iugarius." In *Lexicon Topographicum Urbis Romae*, vol. 5, edited by E.M. Steinby, 169-170. Rome: Quasar.
- Vita-Finzi, C. 1969. *The Mediterranean Valleys: Geological Changes in Historical Times*. London: Cambridge University Press.
- _____. 1976. "Diachronism in Old World alluvial sequences." *Nature* 263: 218-219.
- Waarsenburg, D.D.J. and H. Maas. 2001. "Gods, men and money. Reflections on a protohistoric bronze hoard from the temple of Mater Matuta at Satricum (Latium)." In *Interpreting Deposits: Linking Ritual with Economy*, edited by A.J. Nijboer, 45-56. Groningen: Groningen Institute for Archaeology.
- Waite, T.D., K. Chaintarli, C.R. Beck, A. Bone, R. Amlot, S. Kovats, M. Reacher, B. Armstrong, G. Leonardi, G.J. Rubin, and I. Oliver. 2017. "The English national cohort study of flooding and health: cross-sectional analysis of mental health outcomes at year one." *BMC Public Health* 17: 129.
- Walsh, K. 2014. *The Archaeology of Mediterranean Landscapes: Human-Environment Interaction from the Neolithic to the Roman Period*. New York: Cambridge University Press.
- Ward-Perkins, J.B. 1961. "Veii: The Historical Topography of the Ancient City." *Papers of the British School at Rome* 23: 44-72.
- _____. 1962. "Etruscan Towns, Roman Roads and Medieval Villages: the historical geography of southern Etruria." *Geogr. J.* 128: 389-405.

- Waters, M.R. and D.D. Kuehn. 1996. "The Geoarchaeology of Place: the effect of geological processes on the preservation and interpretation of the archaeological record." *American Antiquity* 61: 483-497.
- Weiland, J. 2011. "Malaria in Etruria." *EtrStud* 14: 97-106.
- Williams, M. 2000. "Dark ages and dark areas: global deforestation in the deep past." *Journal of Historical Geography* 26: 28-46.
- Wink, A. 2002. "From the Mediterranean to the Indian Ocean: Medieval History in Geographic Perspective." *Comparative Studies in Society and History* 44: 416-445.
- Wiseman, T.P. 1986. "Monuments and the Roman annalists." In *Past Perspectives*, edited by I.S. Moxon, J.D. Smart, and A.J. Woodman, 87-100. Cambridge: Cambridge University Press.
- _____. 1995. *Remus: a Roman Myth*. Cambridge: Cambridge University Press.
- _____. 2000. "Review of A. Carandini, *La Nascita di Roma*." *JRS* 90: 210-212.
- _____. 2007. "The Prehistory of Roman Historiography." In *A Companion to Greek and Roman Historiography*, edited by J. Marincola, 67-75. Malden: Blackwell Publishing.
- _____. 2008. *Unwritten Rome*. Exeter: University of Exeter Press.
- Witcher, R. 2005. "The extended metropolis: Urbs, suburbium and population." *JRA* 18: 120-138.
- Witcher, R. and S. Kay. 2008. "The Tiber Valley project: the database and Geographical Information System." In *Mercator Placidissimus: The Tiber Valley in Antiquity: New research in the upper and middle river valley, Rome 27-28 February 2004*, edited by F. Coarelli and H. Patterson, 417-430. Rome: Edizioni Quasar.
- Woodward, J.C. 1995. "Archaeology and human-river environment interactions." In *Mediterranean Quaternary River Environments*, edited by J. Lewin, M.G. Macklin, and J. Woodward, 99-102. Rotterdam, NE: Balkema.
- Zedeño, M. 2000. "On what people make of places: A behavioral cartography." In *Social Theory in Archaeology*, edited by M. Schiffer, 97-111. Salt Lake City: University of Utah Press.
- Zetzel, J.E.G., ed. 1995. *Cicero: De Re Publica*. Cambridge: Cambridge University Press.
- Zevi, E. 1995. "Demarato e i re "corinzi" di Roma." In *L'incidenza dell'antico: Studi in memoria di Ettore Lepore*, edited by E. Lepore and A. Storch Marino, 291-314. Naples: Luciano.

Zuchtriegel, G. 2015. "Archaic Latin Sanctuaries: Ritual Consumption in the Mediterranean Context." In *Sanctuaries and the Power of Consumption: Networking and the Formation of Elites in the Archaic Western Mediterranean World. Proceedings of the International Conference in Innsbruck, 20-23 March 2012*, edited by E. Kistler, B. Öhlinger, M. Mohr, and M. Hoernes, 459-471. Wiesbaden: Harrassowitz Verlag.